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Telephone Engineer

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Telephone Engineer

Volume 31 MARCH, 1927 Number 3

Outlook Rosy; Business Growing; Replacements Numerous

It is the annual custom of this journal to collect information regarding construction plans of telephone companies and to publish summaries of the replies received. Our spring construction feature gives a broad picture of what may be expected in the construction field during the succeeding construction season.

Reports from individual companies indicate that 1927 will be another year of substantial activity in the industry. It could scarcely be otherwise with the business growing at the rate of 800,000 stations annually. Not only is the business growing but as the plants become older, replacements are getting to be a matter of annual occurrence and will require more and more material and labor as the years pass.

The compilation of this information is of interest as it shows the progress that may be expected in the industry during the year and it is hoped that it also may spur the laggard who, seeing what others are doing, is aroused to activity in improving his own property.

Not a Field of Big, Quick or Easy Fortunes

"There are not any 'telephone fortunes,'" says President Walter S. Gifford of the American Telo. & Tele. Co., in his annual report to stockholders. He refers to the wide distribution of the ownership of the Bell System. In spite of the fact that the telephone is one of the greatest inventions of an age of large fortunes, neither the inventor nor the early backers made a large fortune from it and today there is no large fortune that may be pointed out as "telephone fortune."

The telephone industry has not been a field for the creation of great, individual fortunes like those of Ford, Field, Carnegie, Clark, Hill, Vanderbilt, Rockefeller, and others in the fields of motors, merchandising, manufacturing, mining, railroads and oil. None of the men who have been associated with the Bell System ever have accumulated fortunes that would be termed "large" in present days. In the Independent field, likewise, no great fortunes have been made, either by those who rose in meteor like prominence in promotion days or by those who have plodded along in the operation of the systems that have been built up. The best that can be said is that the telephone business has yielded a modest competence to those who have given their best efforts to it.

Perhaps some of the gentlemen who are engaged in present-day promotions of telephone consolidations and reorganization might do well to consider this condition in the telephone industry and if their sole purpose of engaging in the business is to accumulate a quick fortune, they may direct their efforts to more fertile fields of endeavor while the "getting is good."

Increase Toll Business Is the Way to Grow

The large increases in traffic that have been found to result from improved long distance service have been a source of interest and, perhaps, of surprise to telephone men. Reference frequently has been made to the great reduction in time of completion due to C-L-R methods of toll operating and to other improved methods as, for instance, the A-B toll or two-number method of operation. Wherever there has been a reduction in time of completion, the volume of traffic has increased proportionately. In one instance, for example, the installation of A-B toll operation between a metropolitan area and an outlying city resulted in a thirty-three per cent increase in the number of calls per day within a four-month period after the method was installed.

If the larger centers can profit by increased speed of toll service, the question naturally arises as to whether the smaller exchanges may not also profit. Probably, every village in the country is dependent to some extent on a larger nearby town, just as the larger town is dependent upon the city. It is rea-

sonable to expect that the telephone users in the village will talk more frequently to the larger town if the service is improved, just as it has been demonstrated that the people in the town will talk more frequently to the city.

Statistics of the industry show that the growth in telephone stations in the smaller communities has not kept up with the growth in the cities. Saturation is more nearly reached in the smaller towns and no large increase in stations is to be expected. The most promising field, therefore, for increase in business is in the toll business. The way to increase this business has been shown and it only remains for the smaller telephone property to adopt in modified form, as may suit local conditions, the methods that have increased toll business in metropolitan areas.

Bell Report Indicates Present and Prospective Prosperity

As usual, the annual report of the Bell System is a document of absorbing interest. It is a record of progress for 1926, which compares favorably with that of any other year. In every department of the industry, the Bell companies seem to be in an enviable position. The earnings per share of the parent company reached a high point of $11.95—the largest in the past 20 years—and this in spite of a reduction of one-half per cent in the charges made for service to associated companies and an adjustment of long distance rates amounting to a reduction of $3,000,000 annually. The effect of the latter reduction is not fully felt, however, as it has been effective only since October 1.

The financing of the system was carried on almost entirely by the sale of common stock of the American Telephone and Telegraph Co., the only bond issue of consequence being the sale of $40,000,000 of 4½ per cent bonds by the New England Telo. & Tele. Co. During the year the broadcasting interests of the company were sold and the company definitely withdrew from the field of program broadcasting. Although the fact is not mentioned in the report, the use of telephone wires for broadcasting from a chain of stations continues and it may be assumed that a substantial revenue is derived from this use of the long distance lines.

The gradual clearing up of rate controversies is indicated by the absence of even a single reference to them in the report. While some of the subsidiary companies still are involved in rate cases, the greater number have been adjusted and the general results from operation of the entire system indicates that telephone rates, barring a few isolated cases, now are on a fairly satisfactory basis. Whether future rate increases will be necessary on a large scale depends largely upon whether operating economies can compensate for the gradually increasing charges, due to increased investment per station as the size of the system increases.

Altogether, the report indicates a very healthy condition in the Bell system and this means throughout the industry as a whole. There is nothing to suggest that 1927 will be markedly different from 1926, and the industry, accordingly, can go ahead in confidence that another and still more years of progress and prosperity are before it.

What Makes Objectors? It's Worth Finding Out

Every telephone company has its share of difficult problems in public relations and has a certain number of people among its customers who are regarded as being hard to handle. Not only do these people originate many service complaints but they also are, frequently, the objectors in such matters as pole locations and particularly in tree trimming.

Many times, for no apparent reason, a supposedly satisfied subscriber becomes a chronically dissatisfied one. Often rights that were cheerfully granted to run wires over property are withdrawn, trimming has been refused on trees that have been trimmed annually for years, and other annoyances are placed in the way of the telephone company.

Cases of this type call for the exercise of a great deal of tact and diplomacy on the part of the telephone company's representative who is called upon to handle them. In a surprisingly large number of cases, the difficulty will be found to be due to some small occurrance that never has been called to the attention of those in authority in the telephone organization.

Perhaps a careless lineman left a gate open and stock wandered in or out; perhaps, trees were butchered instead of being trimmed properly; perhaps, an anchor was set over a fence line without permission. Any one of a number of things may have happened. Usually the most difficult part of the task of adjustment in cases of this type is to find out what is the real cause underlying the complaint. All sorts of trivial matters may be alleged without a hint of the real cause. Once the cause is discovered, however, and a real attempt made to give relief or satisfaction, the objections generally disappear and the chronic objector becomes a friend of the company, ready to assist it in any possible way. The difference this makes is worth an earnest effort on the company's part.

Reports Indicate 1927 Will Be Prosperous Year

Reports which TELEPHONE ENGINEER has received this month from almost every quarter of the field indicate a favorable outlook for the coming year. Generally speaking, conditions are good and based on the fact the majority of telephone companies are planning for even more than the usual amount of new building, extensions and improvements. The item of replacement, either in part or in whole, continues to grow and to affect an increasing number of companies. Most companies now are getting better rates or will get increases soon. The natural growth in their localities and the prosperous conditions that are prevalent in most communities account for the increases in plant facilities that so many companies find they now have to provide.

Only a few temporary conditions—and those confined to limited areas—are among the "blue notes" to be found in this year's reports and predictions. Among them are noted such happenings as local floods and crop failures, Florida's boom recession, low prices for grain and unfortunate, over-capitalized mergers. On the whole, the spirit of the returns breathe abundant optimism. The industry in 1927 will do more work and make greater progress than during any previous year in its history.

Ill., Palestine—La Motte Co-op. Tele. Co. plans new cable and general repairs.

Ill., Potomac—Potomac Telephone Co. intends to rebuild one of its plants this season and will do about $2,500 worth of overhead work. Among the supplies needed insulators, white cedar poles, southern creosoted poles, iron wire and general supplies.

Ind., Aurora—Southern Indiana Telephone Co. contemplates certain toll line extensions to the extent of $10,000 or more. The company is nearing the 2000 mark, growing at the rate of about 50 a year.

Ind., Greenfield—Greenfield Telephone Co. will renew 27 miles of toll circuits with No. 10 copper wire. About $2,000 worth of underground work and a small amount of inside work also are planned.

Ind., Lapel—The Lapel Telephone Co. will do considerable work in all departments this season and will need anchors, cross arms, batteries, operators chairs, construction supplies, switchboard cord, construction tools, hole diggers, jacks, linemens tools, pole line hardware, white cedar poles, solder, terminals, test sets, toll tickets, transmitters, telephones, iron wire, rebuilt apparatus and genral supplies.

Ind., Monroeville—Monroeville Home Tele. Co. contemplates a mile and a half of rural cable in its work for this season. Among items desired are local cable, cable hangers, cable rings, guy clamps, cable compound, creosoted wood conduit, fibre conduit, conduit rods, pipe pushers, poll line hardware, and EBB wire.

Ind., Otterbein—Otterbein Telephone Co. reports general work only on its schedule for the year. This company is showing a steady, healthy growth.

Ind., Pendleton—Pendleton Telephone Co.'s plans include about $1,000 worth of aerial cable work for 1927.

Ind., Warsaw—Commercial Telephone Co. may lay about 4,000 duct feet of clay conduit this year.

Ia., Clarinda—Farmers Mut. Telo. Co. has some $5,000 of underground work on its program for this season. The company is showing a substantial growth each year.

Ia., Fayette—Fayette Co. Mut. Telo. Co. will devote its attention this year to getting its present lines in better condition.

Ia., Redfield—Redfield Mut. Swbd. & Telo. Ass'n writes that it is in the market for 6-20 white cedar poles.

Ia., Stanton—Farmers Mut. Telo. Co. reports following articles wanted: White cedar poles, telephones, transmitters, and No. 12 BB wire.

Kans., Burr Oak—Farmers Mut. Telo. Co. has work to do in overhead and inside plant and will want cross arms, batteries, insulators, pins, pruning tools and No. 14 BB wire.

Mich., South Haven—Van Buren Co. Telo. Co. wants multigraph equipment.

Minn., Blue Earth—Blue Earth Valley Telo. Co. plans considerable cable work—both overhead and underground.

Minn., Watertown—Watertown Telo. Co. reports following wanted: Anchors, lightning arresters, brackets, operators chairs and protective equipment.

Minn., West Concord—United Telephone Co. contemplates general overhauling for 1927. Some of the things wanted will be: Cable hangers, construction supplies, general supplies, protective equipment and rebuilt apparatus.

Mo., Milan—Farmers Telo. Co. has, chiefly, cable work on its schedule for 1927.

Mo., Richland—Richland Telo. Co. is in the market for general supplies, wire and test sets.

Neb., Gobbin—Farmers Home Telo. Co. reports cable construction as the bulk of its work for this year. Items wanted are: White cedar poles, Southern creosoted poles and No. 12 iron wire.

Neb., Pierce—Pierce Telo. Co. plans about $2,000 worth of underground work and will need cable compound, creosoted wood conduit, tape, etc.

N. Y., North Creek—North Creek Telo. Co. will want for its season's work: Anchors, cross arms, brackets, construction supplies, insulators and white cedar poles.

N. D., Pekin—Cheyenne Telo. Co. writes that it is a little early yet to outline its plans.

O., Archbold—Archbold Telo. Co. will have some replacement to look after this year. Supplies needed include: Cross arms, brackets, pole line hardware and wire.

O., Richwood—Richwood Telo. Co. has considerable rebuilding of pole leads planned for this year.

Pa., Erie—Mutual Telo. Co. reports extensions planned for the current season, involving about $55,000 worth of overhead work and $20,000 underground. The Mutual company has increased 3,000 subscribers the past year and expects to take on 1,000 to 1,200 more until the next twelve months.

Pa., Knox—Rural Telo. Co. is in the market for terminal boxes, lead cable, cablerings, bridle rings, drop wire and general supplies.

Pa., Le Roysville—Peoples Consol. Telo. Co. plans general repairs, and will want switchboard cord, an A. C. 110-volt, 60-cycle rectifier with ringing machine to match, test sets, torches, rebuilt apparatus and general supplies.

Pa., Manheim—Mastersonville Telo. Co. wants an Addressograph, batteries, telephones, etc.

S. C., Abbeville—Abbeville Telo. Co. plans some new cable work—about $2,000 on the pole line and $3,000 on the overhead, with following items needed; terminal boxes, brackets, lead cable, cable rings, operators chairs, cable compound, directories, fuses, insulators, office forms, pins, rebuilt apparatus, telephones, transmitters and 14 BB wire.

S. D., Avon—Dakota Public Service Co. will need for its coming work:

Anchors, lightning arresters, white cedar poles, toll tickets and galvanized wire.

Tex., Hughes Springs — Hughes Springs Telo. Co. plans extensions and will want: Lightning arresters, batteries, magneto bells, fuse blocks, expansion and toggle bolts, terminal boxes, brackets, lead cable, ground clamps, guy clamps, coils, cable compound, wire connectors, switchboard cord, fuses, insulators, knobs and cleats, pay stations, pole line hardware, white cedar poles, rebuilt apparatus, guy rods, telephones, terminals, test sets, transmitters and wire.

Spokane, Wash.—A construction budget of $145,600 for 1927 is the program of the Interstate Utilities Co. with headquarters here. The company now has 31 exchanges in northern Idaho and eastern Washington. These exchanges serve 11,011 owned stations and 2,153 additional stations, leased or locally owned. Gross revenue for 1926 was $583,318.73 and expenses $447,396.81, leaving net earnings of $135,921.92. Interest charges were $72,256.19, leaving $63,665.73 available for deferred charges and dividends. Vice-President John F. Davies states that actual plant values are in excess of book values and his judgment is that the company is entitled to a larger earning which is expected to come in time. The wisdom of the purchase of new properties in 1925 already has been highly demonstrated, says the company's report, and will be even more convincing as the years go by.

Wis., Sparta—Monroe Co. Telo. Co. is in the market for an Addressograph, anchors, automatic telephones, batteries, brackets, operators chairs, coils, cable compound, condensers, construction supplies, directories, furnaces, fuses, generators, pruning tools, receivers, guy rods, solder, tape, terminals, test sets, torches and No. 12 iron wire.

Wis., Wautoma—Wautoma-Mt. Morris Tele. Co. is in the market for No. 12 galv. wire.

N. Y., Granville—Granville Telephone Co. will do considerable work on its cable and pole lines, as well as its buildings. Present estimates call for $25,000 on overhead construction, $15,000 on pole line, $500 on underground work and $10,000 on the inside jobs.

Calif., Corona—Corona Home Tele. & Teleg. Co. will build an addition to its central building and install new central office equipment. Other items desired are an Addressograph and Pay Stations.

Chicago, Ill.—Chicago Trust Company and R. F. DeVoe and Company, Inc., offer $1,200,000 first mortgage 31 year 5½ per cent sinking fund gold bonds on the Knapp properties of northern Ohio.

Hand Telephones in New York—Forbid "French" Phones

New York City — The New York Telephone company will soon make available hand set telephone instruments to its subscribers who have need for them.

J. S. McCulloh, President of the company states that these instruments are not better telephonically than the usual desk sets and wall sets, but will be supplied to meet the wishes of those subscribers who feel they are more convenient.

"There have been experiments with hand sets in the Bell Telephone system for many years, but the engineers were not willing to adopt hand sets until one could be devised that would give the same high and uniform grade of service which the best desk or wall sets give. One of the reasons for the poorer service of previous hand sets is that when the transmitter is on a movable handle, it is in the hand set, and that handle may be held in any position, the transmitter will not work as well as when it is in a desk or wall set designed to remain in an upright position.

"However, about five years ago the American T. & T. Co. in its Bell Telephone laboratories, discovered a principle by which the difficulties of giving good service when using a hand set could be overcome. Even after the principle was discovered, it took an immense amount of work to embody it in a hand set capable of manufacture on a large scale and at a price that would not greatly increase the cost of telephone service to those who wish to use the hand set.

"These problems have now been solved by the research engineers and later in the year, as manufacture proceeds, the New York Telephone company will be in a position to begin the installation of hand sets at a small increase in monthly charges, plus the usual change of instrument charges, to any who desire this type of instrument.

"It has been the custom of the company once or twice a year to explain to our subscribers why we cannot provide good service if they add to or change the apparatus which the telephone company furnishes. It is so essential that only apparatus of high and uniform quality, subject to testing and repair or replacement by the company be used, that the company does not sell apparatus to its customers, but only contracts to render service over the instruments which it furnishes and which it keeps in order.

"The use of other instruments not only impairs the service of the person who uses them but impairs that of every one else with whom he is connected. It is for this reason that the New York company is sending out with the March 1st bills a notice to its subscribers that the use on its lines of the so-called 'French 'phone' or other telephone sets than those furnished by the New York Telephone company is a breach of the contract which each subscriber signs with the company.

"Moreover, the New York company had already notified the distributors of these 'French' telephones that to solicit subscribers to purchase telephone instruments for use on New York Telephone Company lines is tantamount to inducing the subscriber to break his contract with the New York Telephone Company, and that it is against the public interest to sell people instruments for purposes for which they cannot use them."

Pittsfield (Ill.) Insures Its Employees

Pittsfield, Ill.—Through the purchase of a co-operative group insurance contract, the Pike County Telephone Company, has provided its employes with life insurance totaling more than $40,000, as well as liberal benefits under the terms of a health and non-occupational accident policy.

In the principle classification, each insured woman receives $500 and each man $1,000 of life insurance. Health and accident benefits are based on an employee's salary. Beginning on the eighth day of disability due either to sickness from any cause or injury received while off the job, the benefits are payable for a maximum of thirteen consecutive weeks.

Included in the life insurance contract, is a total and permanent disability clause, which provides for the payment of life insurance, in monthly installments, to any employee who becomes totally and permanently disabled before age 60.

Premiums are paid jointly by employer and employee.

Work Started on Canada's Second Transcontinental Line

Montreal, Que.—The Canadian Pacific system has started work on a second trans-Canada telegraph line, 3,000 miles in length, extending from Montreal to Banfield, on Vancouver Island, passing through Sudbury, Fort William, Winnipeg, Moose Jaw, Calgary, Nelson, Penticton, Vancouver and Alberni. At Bamfield the line will connect with the second Pacific Cable Board undersea circuit that goes to Fanning Island, Suva, Auckland, and Sydney. The work will be completed in about two months, at an estimated cost of about $423,520, and will forge another link in the chain between Great Britain, Canada, New Zealand, and Australia.

Osborne, Kan.—Central Kansas Telephone company has bought the Osborne Telephone company.

New York City.—Of a total of 388,121 American T. & T. company shareholders 218,852 are women.

The Wheatstone Bridge—Its Principle and Operation*

By F. J. DOMMERQUE
Fellow A. I. E. E.

The importance of the Wheatstone bridge for the telephone man rests not only on its usefulness as a measuring instrument in locating troubles and faults, but it comprises also the little recognized fact that the bridge principle is fundamental to a number if not to all the circuit combinations peculiar to modern telephony. To show the theoretical arrangement of the Wheatstone bridge, four resistances are joined together to form a parallelogram as indicated in Fig. 67, where the resistances are designated

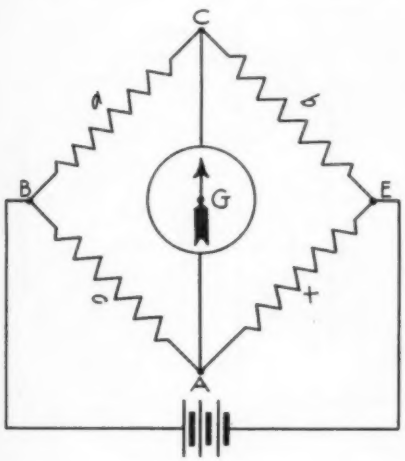


Fig. 67

by a, b, c and x respectively. In Fig. 68 the same resistances are repeated, but three of them, a, b, and c are provided with a traveling contact, which, when moved back and forth, permits of adjusting the resistances. The resistances a, b and c are known resistances and x is the unknown resistance to be measured. Fig. 68 contains also a switch to cut the battery in and out, which is omitted in Fig. 67. Both figures contain also an instrument G of a character to be described later. For simplicity's sake we use the Fig. 67 to illustrate the bridge principle, although the working instruments have mostly adjustable resistances.

As will be noticed the battery is placed in series with one diagonal of the parallelogram and the instrument G in the other diagonal.

When the four resistances forming the sides of the bridge are so adjusted that the needle of the instrument G is in its zero position—that is, does not give any indication—no current will flow through the instrument G; in this condition the four resistances bear a certain relation to each other. When there is no current flowing between the points A and C, the instrument G may be removed without altering the current in the sides or arms (as they are frequently called) of the bridge. Also the points A and C may be short-circuited; that is, connected directly by a wire, without interfering with the balance of the circuit.

The absence of a current on connecting the points A and C together is a clear proof that those two points were at the same or equal potentials. As the wires connected together at B are always at the same potential, and also the wires connected together at E, it follows that the fall of potential along BCE must equal that along BAE. It also follows that the difference of potential between B and C is equal to that between B and A; call this P_1. For the same reason the difference of potential between C and E is equal to that between A and E; call this P_2. Suppose the current flowing in the upper branch BCE to be C_1, and that in the lower branch BAE to be C_2, then by Ohm's law $P_1 = C_1 \times a$ and also $= C_2 \times c$; therefore $\frac{a}{c} = \frac{C_2}{C_1}$. It is also $P_2 = C_1 \times b$ and also $= C_2 \times x$; therefore $\frac{b}{x} = \frac{C_2}{C_1}$; consequently $\frac{a}{c} = \frac{b}{x}$, whence $x = \frac{bc}{a}$.

Therefore if three of the quantities of this equation are known, the fourth can be easily determined as the following example shows: Assuming the instrument G of the bridge had gone to its zero position after the resistances in the three arms a, b and c had been adjusted to the following value: $a = 10$ ohms; $b = 35$ ohms and $c = 8$ ohms. Inserting these values in the equation $x = \frac{bc}{a}$, we obtain $\frac{35 \times 8}{10} = 28$ ohms for the unknown resistance.

All three arms of the bridge, a, b and c may be made adjustable resistances formed of a number of coils whose value has been previously determined, or two of them may be fixed known resistances and the third an adjustable resistance. a and c may be made of equal value, or one of the two may be 10,100 or 1,000 times as great as the other, or any multiple that may be desired. If a is made ten times as large as c, the resistance in b will be ten times as large as x, and thus every unit of resistance in b will represent one-tenth of a unit in x. Similarly, by making b, 100 or 1,000 times as large as a, the value of x may be correspondingly ascertained to be one-hundredth or one thousandth of a unit. If c be made 10, 100 or 1000 times as large as a, each

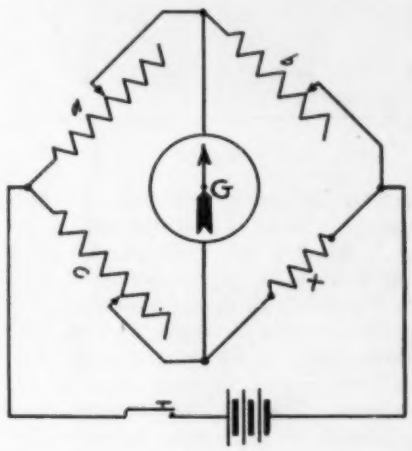


Fig. 68

unit in b must be multiplied by 10, 100 or 1,000, respectively, to give the value of x. By this means it is practicable to make the bridge measure very small and very large resistances with fair accuracy. It is obvious that the sensitiveness of the instrument G employed to detect the current flowing between A and C forms a large factor in the accuracy of the bridge measurements. The more sensitive the instrument, the smaller the current it will be possible to detect in case of current measurements, and the nearer the bridge arms can be brought to an exact balance in case of resistance measurements.

For very delicate measurements the moving coil galvanometers with suspended needle are best suited. Then the bridge, of course, must be stationary. If it is desirable to have the bridge so arranged as to be portable, the galvanometer to be used must be constructed accordingly by winding the coil wire upon a very light metal frame, which is pivoted in jewel bearings. A pointer, long and light, is attached to this coil, the free end of which is pointed and moves over

*Twelfth article on Telephone Mathematics and Physics.

51. The Wheatstone Bridge Principle

a scale. This kind of arrangement will be described some time later under voltmeter and ammeter methods. A very convenient and portable form of testing set, comprising resistance coils, bridge and galvanometer is presented in Fig. 69. At the left of the cut is located a small D'Arsonval galvanometer of the pivot and jewel bearing type, having the advantage of being dead-beat. A galvanometer shunt is provided with values of 1, 0.1, 0.01 and 0.001, so that these fractional parts of the testing current can pass through the galvanometer. The resistances are arranged on the dial decade plan, by which arrangement one dial only is used for each decade of resistances. There are four decades of ten coils each of units, tens, hundreds and thousands, which make up the "rheostat." The arms of the bridge, A and B, are made up by two half-dials. Fig. 70 serves as a diagram of connections of this bridge set.

Fig. 69

Bridge arm A comprises resistances having the values of 10, 100, 1,000 and 10,000 ohms and is provided with an infinity contact stud, marked INF, so as to permit the opening of the bridge circuit for some measurements.

Bridge arm B comprises resistances having the same values as arm A and also a zero contact stud.

This arrangement of resistances in the bridge arms will provide a ratio of 1 to 10,000 or 10,000 to 1, which includes the measurement of all resistances which come within the range of the Wheatstone bridge method.

In the illustrated bridge the resistance coils are of manganin, so that ordinary changes of temperature do not change their accuracy of adjustment. The resistances are wound non-inductively and are practically free from capacity.

52. Resistance Measurement by Wheatstone Bridge

The terminals of the resistance to be measured are connected to the binding posts marked "LINE" in Fig. 70, and a battery is connected to the posts marked BA by means of flexible cords. By placing the battery connection on any two adjoining studs of battery, one cell of the battery is thrown into the circuit, which is sufficient for rough balance. The small knife switch is then placed at W. B. and the galvanometer shunt S turned so that the pointer indicates 0.1; a 100 ohm coil is placed in each bridge arm and 1,000 ohms switched in the rheostat. Then the battery key BA is pressed and holding it down momentarily, the galvanometer key GA is pressed. If the galvanometer swings toward + side, the resistance in the rheostat is too high and should be reduced; if the deflection is toward — side, the resistance is too low and should be increased. By changing the resistance in this manner a value will soon be found

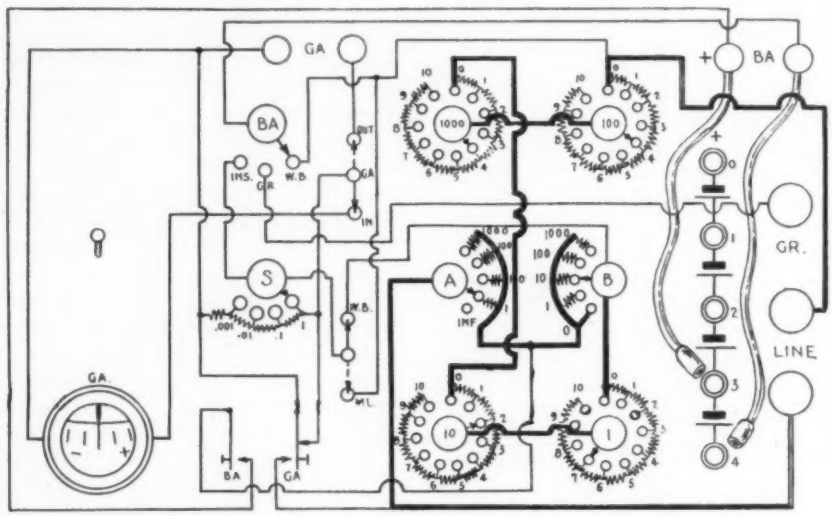


Fig. 70

where no galvanometer deflection is produced even when all cells are in circuit. If, however, the deflection continues to + side, even with rheostat resistance very small, then make A less by switching either to 10 or 1 and again balance until galvanometer shows no deflection.

With bridge arms of equal value, this is the best result that can be obtained, but by choosing more suitable values for the two arms, a considerably higher degree of accuracy may be secured. The following table shows the values of A and B, respectively, to be chosen, when measuring any resistance within the range of the set.

Below 1.5 ohms, make	A = 1	B = 1,000
Between 1.5 and 11 ohms, make	A = 1	B = 100
Between 11 and 78 ohms, make	A = 10	B = 100
Between 78 and 1,100 ohms, make	A = 100	B = 1,000
Between 1,100 and 6,100 ohms, make	A = 100	B = 100
Between 6,100 and 110,000 ohms, make	A = 1,000	B = 100
Between 110,000 and 1,110,000 ohms, make	A = 1,000	B = 10
Between 1,110,000 and 11,110,000 ohms, make	A = 1,000	B = 1

53. The Slide Wire Bridge

The Wheatstone bridge is just described is a rather expensive instrument, and as there are a great number of measurements in telephone practice which can be made with a less costly constructed instrument we will describe one which is so simple that it can easily be put together by any telephone man. Of course this bridge is not as sensitive as a real Wheatstone bridge, but it is surprising how much can be accomplished with it.

In the skeleton diagram, Fig. 71, is shown the principle of this "Slide Wire Bridge," as it is called. A uniform wire is stretched upon some kind of insulating base between the points marked A and B. The connecting links between the terminals of the wire and the terminals between which the resistances "c" and "x," to be compared, are inserted, should be heavy conductors or bars of copper. Along or under the stretched

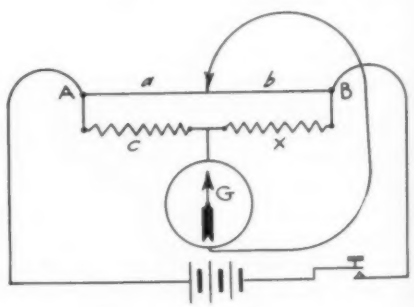


Fig. 71

wire and parallel to it a scale is usually fastened reading both ways from its middle. Then the ratios of the resistances c and x may be read from the two segments into which any contact point, gliding along the wire divides the latter. The contact point is connected through a gal-

vanometer or a set of head telephones, which indicates by silence the balance of the bridge, to the middle point between the resistances c and x. For the balance of the galvanometer or silence of the telephone we have the equation $x = \frac{b}{a} c$.

To increase the sensitiveness of the combination, two resistances may be added, one at each end of the wire AB. If the resistances are made equal and dimensioned so as to present combined nine times the resistance of the wire AB, the effect will be the same as if AB were the middle piece of a wire ten times the length of AB.

Now to construct such a bridge at home, reference is taken to Fig. 72. First of all buy in a store of which there are sprung up many selling radio supplies, four or five standard resistances. From these make up other standards of adequate accuracy, sufficient to permit of measuring from 1 to 10,000 ohms or more. It should not be difficult to wind these resistances so as to be not more than 5 per cent out of the way. In winding these resistances, wind them double so as to avoid inductance; that is, cut off a piece of wire of the right length, double it up and start winding from the closed end, bringing thus the open ends of the wire to the outside. These standards constitute the known resistance,

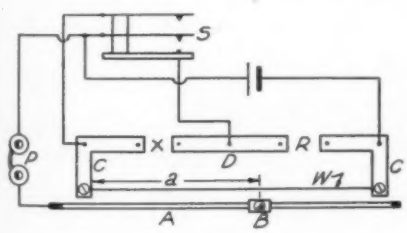


Fig. 72

which is used as a basis for comparison. They are inserted in the space marked R in Fig. 72. The unknown resistance is connected in the space marked x.

The arms C and D are made of brass strips. The slide wire W is best made of high resistance wire (not copper) not less than No. 30 B. & S. gage and fastened to, or clamped, under the brass pieces C. The support A, upon which the sleeve B slides, should be of square brass rod. The sleeve B should have knife edge to make a good contact on the wire W. The scale is not shown in the diagram; it is advisable to use a paper scale one meter long divided into millimeters, such a one as can be brought at any drawing material store; it should be placed under the wire. Using a meter scale would necessitate making the size of the baseboard at least 42 inches long, a rather cumbersome affair; therefore, it is recommended to use only a half meter scale (500 mm.). Of course in that case the formula for the balance would have to be modified so as to read $x = \frac{a}{500 - a} \times R$. In case of a meter scale the formula to be used would read $x = \frac{a}{1000 - a} \times R$.

A pair of head telephones are shown to take the place of the galvanometer. The sleeve B is moved until no click is heard when the circuit is closed. The

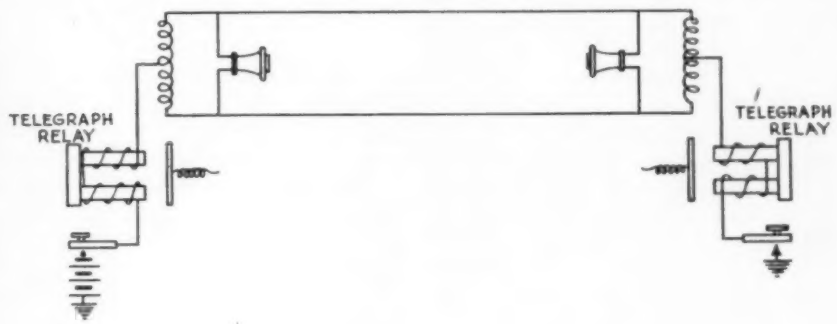


Fig. 73

position of the knife edge on the wire gives the value of a, from which the known resistance x is calculated. Often an ordinary switch is used for closing the circuit, which may cause a click and thus cause an error. For this reason the double contact switch is shown in the diagram, which will avoid capacity clicks.

At the beginning of this paper it was stated that the bridge idea was fundamental to a number of circuit arrangements peculiar to modern telephony. Take for instance a circuit which affords the possibility of telephoning and telegraphing over the same line. A description of the circuit is not necessary, but it may be pointed out that, as shown in Fig. 73, the telegraph instrument at each end of the circuit is connected to the center of the repeating coil, thereby effecting a *balance* between the two sides of the circuit. This balance requires the resistances on both sides to be equal.

By using two circuits and connecting them in the manner shown diagrammatically in Fig. 74, the well-known phantom circuit is obtained, which, as is easily recognized, consists of the application of the Wheatstone bridge idea to two circuits.

These two examples are only special cases. It is essential that telephone lines are properly balanced to keep transmission free from induction. A perfect

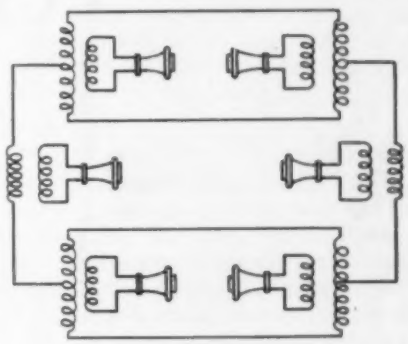


Fig. 74

balance will never be achieved, but the unbalance can be kept in such close limits as to make commercial transmission possible.

The principle of the slide wire bridge is applied frequently to measuring or testing instruments used in transmission tests, such as "correctness of loading" testing sets. Here a slide wire of 50 ohms resistance is bent into a circle for easy working; and over the wire slides a contact arm pivoted in the center of the circle; the scale being also circular and calibrated so as to show the percentage of unbalance of the circuits under test, which may be aerial or underground duplex cable circuits.

Its extension resistances are 100 ohms each and can be thrown in and out of circuit by a switch. To indicate the balance of the circuits a telephone receiver is used. With the three cell battery a tone generator, consisting of an induction coil with an interrupter attachment, is employed. The contact arm should be in the zero position when no connections are made and with the extension resistances in or out.

To measure impedance unbalance resistances are introduced and the readings are in fractions of ohms.

To use the testing set for capacity unbalance measurements, capacities are introduced instead of resistances to obtain a balance of a difference of percentages and the readings will be in micro-microfarads.

All this is very interesting, but to go into its discussion would lead too far from our problem.

Big Storm Brings Havoc to New York and New Jersey

Wind, sleet, fire and flood worked hard late in February to obstruct the telephone service of Metropolitan New York and some sections of New Jersey. The damage was the greatest since the famous storm of 1914.

Studying Magnetism in Telephone Work

SECOND STUDY INSTALLMENT

By E. R. COLLINS

Wire Chief, Manitoba Telephone System, Brandon, Manitoba, Can.

Permanent Magnets

The first piece of apparatus we encounter in the study of the electrical part of the telephone system is the permanent magnet. As its name signifies, a permanent magnet is one that retains its magnetic qualities indefinitely.

For the study of the magnetic properties the following articles will be required for experiment:

2 bar magnets from a bipolar receiver.
2 ordinary saucers. (If your wife doesn't catch you.)
1 tray about 12 inches by 6 inches. Any material but iron or steel will do for this.
1 atomizer, filled with acetone. An atomizer with a metal spray is best, as the acetone will spoil any celluloid substance.
12 sheets of celluloid 3 inches by 6 inches. This can be obtained at any automobile top repair shop. The weight used for car curtains is best.
1 knitting needle (steel).
1 copper test clamp, or one copper block as is used for lightning protectors.
2 iron nuts from a ⅜-inch carriage bolt.
1 copper tie wire.
1 piece of silk thread about 6 inches long.
1 wooden block about 3 inches square and a bit of 22 gauge copper wire bare.
1 small quantity of filings of each of the following: Copper, brass, nickel, zinc, lead, wood, hard rubber, steel.
1 glass tube ¼ inch diameter by 4 inches long.
2 corks for glass tube.
1 pocket compass as used by hunters and prospectors.

EXPERIMENT 3

Place one of the bar magnets in a saucer floating in water in the wooden tray. Paint the end which swings north with *red* paint.

Repeat the experiment with the other magnet and mark in the same manner.

We now have two permanent magnets with the end which pointed north marked red. These two north ends are then alike or as we say "Like." The same can be said of the unpainted ends.

This tendency of the magnet to face the north magnetic pole is the reason why we call one end of the magnet the *north pole* and the other the *south pole*.

Should anyone be considering the use of these articles as the basis for work with a class, it is suggested that the organization of the class be deferred until about October. This will bring the class into the best time of year for such work and by that time sufficient number of articles will be available to provide for continuous instruction.—The Author.

We speak of the two ends then as the poles of the magnet, and usually mark them "N" and "S."

EXPERIMENT 4

Now place both saucers in the water and balance both magnets one on each saucer with the like ends together. Observe that they will swing away from each other. The same thing happens when the two red or the two unpainted ends are brought together. The like ends shove apart. We call this magnetic repulsion. The unlike ends, however, will swing and come together. We call this magnetic attraction.

We can therefore write a law of magnetism which is this: *"Like poles of a magnet repel and unlike poles of a magnet attract."*

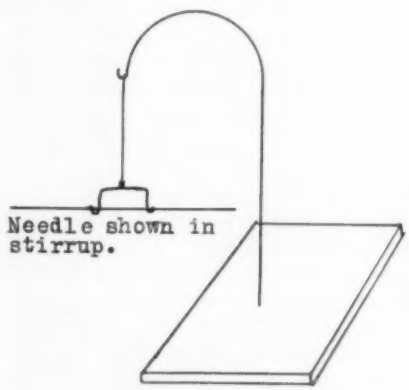


Fig. 3

EXPERIMENT 5

Dip the two ends of a magnet into a box of iron filings and notice that filings will hang in great clusters to either end of the magnet, but none to the center. This shows that the attraction of either end is the same and the middle point is neutral. From this we learn that it is the poles of the magnet we will have to work with to obtain any results.

Repeat the experiment using filings of the following: Copper, brass, nickel, zinc, lead, wood, hard rubber, steel.

It will be observed that the steel has a great response to magnetic influence, nickel some, and the rest are neutral. Therefore for use in our apparatus we will find the working materials to be steel and soft iron.

Magnetic Construction

The theory of the construction of a magnet can be illustrated in the following experiment:

EXPERIMENT 6

Take the copper tie wire and wooden block and silk thread and No. 22 copper wire. Make up a stand as shown in the Fig. 3.

Magnetize the steel knitting needle by stroking one way on one of the bar magnets. Suspend the needle balanced in the stirrup as shown in Fig. 3. The needle behaves as a magnet, as indeed it now is.

Break the needle in two pieces, and repeat the experiment with both pieces. The same behavior will be observed. Check for attraction and repulsion with the two pieces. Continue breaking into smaller pieces until they are too short to handle satisfactorily, test for polarity and for attraction and repulsion. In each case every piece comes under the law of magnetism.

In Fig. 4 the comparison of the parts is shown. Here a north and a south pole are end to end in every case, and when all the pieces are joined together they form one long magnet.

Now if we will let our imaginations have play and suppose the breaking up process was continued until the pieces were so small as to be invisible to the naked eye we would see just what actually happens. The needle is made up of very small atoms, which having both north and south poles are lined up so that they form a complete magnet. They can be disarranged again by heating, or hammering.

EXPERIMENT 7

Using the glass tube about 6 inches long and ¼ inch diameter, close one end with a cork, fill with iron filings, and close the other end also. Examine the filings with a magnifying glass and note

that the filings are in a disorderly formation. Now draw a strong magnet along the outside of the tube several times in one direction. Note that the filings are now arranged in orderly lines. These lines can be easily broken up by shaking if the filings are soft iron.

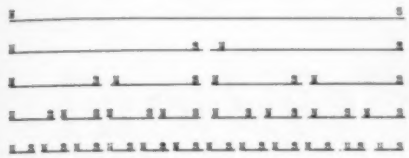


Fig. 4

Repeat the experiment, using steel filings instead of the iron. It will be noted that the steel filings cannot be shaken out of formation as easily as the iron.

In steel the magnetic contact is more perfect and thus a steel magnet will retain its magnetism for a long time. Thus when we require a magnet to hold its power for a long time, we use steel. When we want a magnet to change its attractive power we use soft iron. This will be taken up under the head of electro magnets.

Magnetic Fields

In these experiments we will endeavor to discover why a magnet exerts a pulling influence on objects around it.

EXPERIMENT 7

Lay a bar magnet on the table. Lay over it one of the pieces of celluloid. Place a block of wood under the edges to keep the celluloid level. Take a quantity of the soft iron filings free of grease, and sift through a piece of cheese cloth over the celluloid. The filings will fall on the celluloid in definite lines. Tap gently with a pencil and the lines will become more pronounced. Spray acetone over the filings before removing the celluloid from the magnet. In about 5 minutes the acetone will dry, and the filings will be fixed to the celluloid. Stick a piece of paper on the celluloid with a number on it for future reference.

This celluloid picture will show that there is a force radiating from the two poles of the magnet, spreading out into the space around it. If we could form pictures of all sides of the magnet we would find that this force surrounds the magnet.

We call these lines *magnetic lines of force* and the area of their influence the magnetic field. In the bar magnet we find that the field is badly spread. The distance the lines of force have to travel through the space from the north to the south pole weakens the strength of the field. The iron filings being magnetic are made use of by the magnet to complete its circuit.

EXPERIMENT 8

Lay the two bar magnets side by side with a piece of wood separating them about ½ inch, as shown in Fig. 5. Make a celluloid picture of this formation. In this one it will be noticed that the lines are more clearly marked at the ends or poles of the magnets. There is very little spread outside of the magnets. We have here lessened the gap to the ½ inch between the two poles at either end. The magnetic flow or flux is through the two air gaps at the poles, and the magnets themselves form the rest of the circuit.

EXPERIMENT 9

Lay two magnets side by side as in Fig. 6 with an iron nut between the magnets at one end, and a piece of copper or brass at the other. The celluloid picture will show that the most intense flow is at the end where the copper is between the pole pieces, while the rest of the magnet shows little or no evidence of magnetic flux, as the circuit is completed through the iron nut.

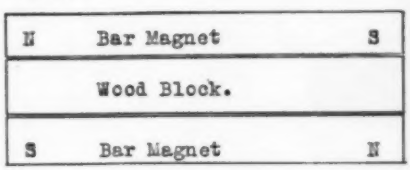


Fig. 5

The same result would have been noticed if wood or brass or zinc, or other non-magnetic substance were used instead of the copper. We call the separation across the copper the magnetic gap. It will be noticed in the above picture that the most intense field we have had is in this formation. Shortening the gap will strengthen the field.

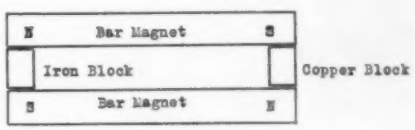


Fig. 6

Closing the gap will increase the field intensity up to the point of saturation, or to the point when all the lines of force are carried across this gap. A magnet has only so many lines to a square inch, and this determines the limit to which we can go.

EXPERIMENT 10

In this experiment make the celluloid picture of the two bar magnets as in Fig. 7. An iron block is in magnetic contact with the pole pieces at either end of the magnets. In this picture we will see that there is practically no evidence of magnetic flow or flux, outside the magnet, as there is little or no formation of the iron filings.

We have formed here what is known as a closed magnetic field. Here all the possible lines of force find a closed low resistance circuit from pole to pole, and there is no magnetic energy left to act on the filings.

EXPERIMENT 11

In this formation we use only one bar magnet and three pieces of soft iron arranged as shown in the drawing. Here we find the most intense field effect at the N pole of the magnet. If we take a compass, or even suspend the other bar magnet in the stirrup used in Fig. 3, we can check the polarity of the pole pieces which are marked S and S.

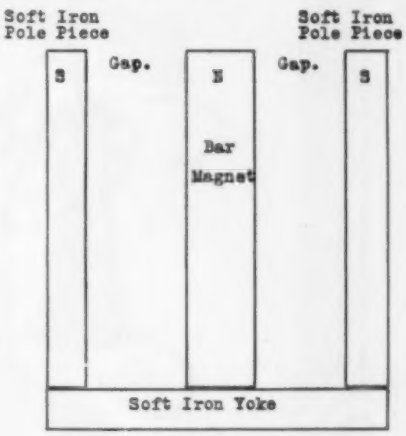


Fig. 7

The two pole pieces will be found to be south polarity or the same as the lower end of the bar magnet. We have therefore constructed a dividend extension of the magnetic flow through the soft iron pole pieces. This formation will be found in the polarized ringer, and will be taken up under the heading of electro magnets.

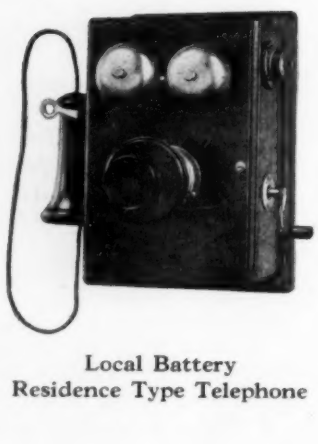
W. H. Crumb Buys Wisconsin Companies and Merges

Chicago, Ill.—Wm. H. Crumb, prominent Independent engineer, has bought the Theresa Union Telephone Co., Random Lake Telephone Co., and Eden Telephone Co., all Wisconsin properties in Dodge, Washington, Sheboygan and Fond du Lac counties. It is expected that additional exchanges will be acquired by Mr. Crumb in Wisconsin and that all of the properties will be unified under his able management. His extensive and successful experience in the telephone field, dating back to 1895, gives him an excellent foundation for profitable management of these properties.

Stromberg-Carlson Wins Sesqui Radio Award

Rochester, N. Y.—To the Stromberg-Carlson Telephone Manufacturing Company—a Gold Medal in recognition of the development and manufacture of a totally shielded radio receiving set with high selectivity free from coil pick-up and objectionable regeneration." Thus reads the Gold Medal which has just been received by the Stromberg-Carlson Company from officials of the Sesqui-Centennial Exposition conducted in Philadelphia during the past year.

Local Battery Desk Type Telephone



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How to Read Telephone Circuit Diagrams

By DAVID S. HULFISH

(Continued.)

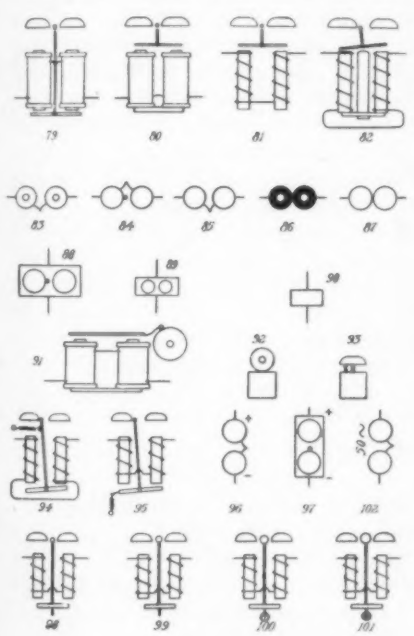
CHAPTER II

Ringers

The common type of ringer has a permanent bar magnet and a pair of spools mounted side by side in the magnetic field. Opposite the ends of the spools is an armature, pivoted at the middle, and carrying a rod and tapper. The tapper hits two gongs. An alternating current through the spools will attract first one end of the armature and then the other, striking the two gongs alternately.

Symbols derived from a side view of the spools and gongs are shown in Figs. 79, 80, 81 and 82; symbols from the end view of the spools are shown in Figs. 83 to 87, inclusive. Fig. 85 is the favorite, and is easy to draw.

Some unusual symbols are shown in Figs. 88 to 93. The box and gongs are shown in 88 and 89; the gongs omitted in Fig. 90 makes a symbol too simple for recognition except with other elements



Figs. 79-102

in the same drawing. The vibrating armature type is shown in Figs. 91, 92 and 93.

In selective systems of ringing, a specialized ringer often is used, and the specialization may be indicated in the symbol. See Figs. 94 to 101.

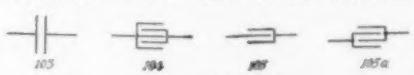
The biased polarized bell is a common instance of such a ringer. This bell is an ordinary ringer, biased by some modification which gives to the armature a tendency to stick always to the same magnet core, in distinction from the ringers of Figs. 79 to 82, where the armatures may stick to either core.

The bias may be given by mounting the ringer sidewise so that the force of gravity acts in one direction only upon the tapper ball, or it may be applied by a spring upon the armature or upon the tapper rod. See Figs. 94 and 95 for this indication of bias in a ringer. Bias is indicated also by affixing polarity signs to the ringer symbol. Thus, in Figs. 96 and 97 there is indicated a ringer which must have a positive pole of a battery or electric generator applied to its upper terminal to operate the ringer to give a signal, the ringing current flowing downward through the ringer to the remaining terminal and then returning to the battery or generator.

Another type of selective ringer is the "harmonic" or "tuned" ringer. The armature is suspended upon a short flat spring or "reed" instead of upon a pivot. The armature is weighted also, usually by a difference in size of the tapper balls, to produce different speeds. The Figs. 98, 99, 100 and 101 show a set of four such ringers. Note the tuning reed projecting from the middle of the armature, and Figs. 100 and 101 show the anchors for the reeds. The Fig. 102 represents a ringer tuned to respond to a frequency of 50 cycles per second and tuned not to respond to ringing currents of other frequencies.

Condensers

The condenser consists of two plates or similar surfaces, near each other but not in conductive contact. Because they are near, an electrical charge upon one plate will "induce" a charge upon the other plate, and thus there is attained the seeming paradox of a current of electricity passing where a conductor does not exist. The amount of current thus

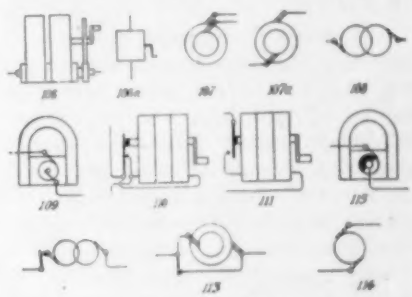


Figs. 103-105

passed is minute, but in the case of alternating currents, these minute quantities follow each other so rapidly that a continuous alternating current is passed. The symbol for condenser therefore may be expected in a conductor where alternating current is required to pass and where direct or continuous current is required not to pass, as in the ringer circuit, or in a circuit for speaking currents.

Three symbols for a condenser are commonly used. Fig. 103 represents two condenser plates face to face. Fig. 104 represents a stack of plates in two systems of leaves, each leaf of each system offering both sides to the opposing system, except the outer leaves. Fig. 105 is the reduction to maximum simplicity of the symbol of Fig. 104 and Fig. 105, perhaps, is best of the three. Fig. 105*a* is a symbol recommended by some authorities.

The common method of manufacture for a telephone condenser is to roll together strips of paper and tin foil; the roll thus formed may be pressed flat or used in its cylindrical form. By reason of this method of construction efforts to picture or to symbolize the rolled condenser and to indicate its rolled form are



Figs. 106-115

likely to be met. With this knowledge of condenser manufacture such efforts will be recognized at once.

Generators

The one distinguishing feature about a hand generator, or "magneto," such as is used upon farm lines and in small exchanges and on toll lines, is the crank. Hence, with any strange looking emblem having an indication of a crank there is great likelihood that it represents a hand generator. See Fig. 106*a* as an example.

The hand generator usually is an alternating current device. Figs. 107 and 108 are symbols for alternating current generators, whether hand driven or otherwise. An arbitrary modification of Fig. 107 is shown in Fig. 107*a*. In all of these symbols the two collector rings upon the armature shaft are indicated, and also the collector brushes which rest upon the collector rings.

Most hand generators have an automatic switch which at first effort to turn the crank is operated to switch the generator into operative relation to the telephone system, the automatic switch operating again to switch the generator out of the circuits when the crank is released. Such a switch is shown as a part of the symbols in Figs. 110 and 111; in these symbols it may be assumed that the operator must push in upon the crank while turning.

Fig. 106 is a side view of a magneto hand generator. Fig. 109 shows a simplified end view of a magneto generator for alternating currents. It embodies a combination of the horseshoe magnets of the generator with the symbol of Figs. 107 and 107*a* for the armature details.

In Figs. 112 and 113 the electrical switches shown in connection with the symbols for alternating current generators indicate the contacts of the automatic switch forming a part of the hand generator. In the generator symbolized in Fig. 112, the armature circuit is open when the crank is not being turned. In the generator of Fig. 113, the armature is shortcircuited when the crank is not being turned.

Fig. 114 is the accepted symbol for a direct-current generator, whether hand or power driven. It is somewhat easier to draw than any other symbol, and it is likely to be found anywhere, even for a hand generator at a substation telephone.

A "pulsating" magneto generator is typified in Fig. 115. In such a generator, one half of the alternating current is suppressed by making one half of the collecting ring of insulating material, thus converting the collector ring into a commutator. Such a generator gives a current consisting of "pulsations" of current always of the same polarity, or flowing always in the same direction, but with intervals of no current between them where the other half of the alternating current is suppressed. Such a current is not a continuous direct current, but is a current suitable for ringing a biased polarized bell, such as those represented by the symbols of Figs. 94, 95, 96 and 97.

Symbols for pulsating magnetos may be expected in connection with biased polarized ringers, particularly on party lines. Combinations of these elements sometimes are made to permit selective signaling from the substations to the central office, as well as vice versa.

Simple System

All of the elements going to make up the usual substation telephone equipments now have been studied and their symbols have been presented. In combining the elements to produce a skeleton diagram of a telephone set, the symbols are drawn upon the page, and are connected by lines representing the wires. The telephone sets thus drawn in skeleton then may be connected with each other by lines representing the line wires.

Some simple system-circuits will be presented and studied, that the student may become familiar with the methods of assembling symbols.

In Fig. 116 is shown a simple common-battery circuit for a private line, without signaling devices, but with transmitters and receivers.

Fig. 116 presents a very simple form of circuit for studying permutations of circuit conditions. Only four permutations exist. First, with the receiver at station A off of the hook, the circuit between the two line wires is closed at that station but open at station B. Second,

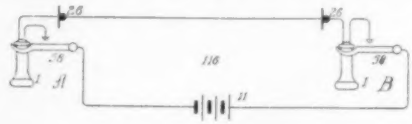


Fig. 116

with the receiver at station B off of the hook and with the receiver at station A on the hook, the circuit between the two line wires is closed at B but open at A. The third condition exists when both of the receivers are off of the hooks. This closes a circuit for current from the battery 11. Note that current may flow from battery 11, to the right to station

Fig. 117

B, upward and through the closed contact of the hookswitch 58 of station B, then through the receiver 1 of station B, then up and to the left through the transmitter 26; then to the left over the line wire to the transmitter 26 of station A, then downward and through the receiver 1 and closed contact of hookswitch 28 of station A and down and to the right over the line wire to the battery 11, thus completing a circuit. Current will flow over this circuit continuously until the circuit is broken, and the only places it may be broken are found at the two hook switches, and presumably only

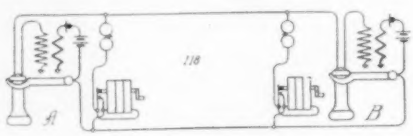


Fig. 118

hanging one of the receivers upon its hook.

The fourth condition of circuit permutation in Fig. 116 is that in which both of the receivers are upon their hooks, the circuit then being broken in both places. This is the condition of rest, as shown in the diagram.

Most circuit diagrams show the apparatus in a condition of rest or idleness, and the various possible, probable or intended conditions of service are left to the reader, to solve by "cut and try" processes, into which all changes are taken into consideration until the proper one, or at least a reasonable one, is found.

In Fig. 117, signaling means are added to the circuit of Fig. 116; otherwise the circuit is the same. Here the permutations are greater in number. Signaling conditions are offered for station A to call station B or for station B to call station A.

Assume that station A desires to call station B. The telephone user at station A turns his hand generator, 112, generating alternating current and closing the automatic switch, shown open, which is a part of the generator 112. Current flows from the generator 112 downward to the lower line conductor and upward to the upper line conductor, and will find two paths between the two line conductors, forming two complete circuits for current.

The nature of the condensers, 105 of station *A* and 105 of station *B*, must be considered; they will pass the alternating current from the generator 112, but will not pass the direct current which the battery 11 is able to give.

Alternating current flows therefore from 112 through the closed automatic switch down to the lower line wire, to the left, up through condenser 105 and ringer 85 of station *A*, to the right and downward to the generator 112. This rings the ringer 85 of station *A*. Alternating current flows also from generator 112 of station *A* down to the lower line wire and to the right, through the battery 11 and to station *B*, up through condenser 105 and ringer 85 of station *B*, ringing the ringer 85 of station *B*. This current cannot flow up through generator 112 of station *B*, because the automatic switch is open when that generator is at rest; neither can the current flow up through the hook switch of either station. Both bells ring when the generator 112 of station *A* is turned.

The normal conditions for Fig. 116 now have been studied. There are some abnormal conditions, however, which are worthy of note. Suppose that the telephone user at station *A*, weary of waiting for station *B* to answer, desired to ring station *B* again, and turned the crank of the generator 112 of station *A* without first replacing his receiver upon the hook, or without depressing the hook lever, then current would flow from the lower line wire up through the hook switch, receiver and transmitter of station *A*, and would "ring in the ear" of the user. Also, the user at *A* may ring into the receiver of station *B* while it is in use, or in case it should be left off of

the hook by intent or neglect. These are abnormal conditions. Another abnormal condition is the turning of both generators at the same time.

The consideration of abnormal conditions has its principal use in the matter of testing out a circuit informally to detect faults; such consideration is necessary also in studying a new circuit, to determine whether there are any abnormal conditions which are at all likely to occur which would make the line or the system inoperative.

A line having local battery transmission of speech is shown in Fig. 118, with two stations, *A* and *B*. A further difference from the circuit of Fig. 117 is the arrangement of generator and signal bell, the arrangement of Fig. 118 being for what is known as "series" ringing.

In studying first the signaling elements of the line, a call from *A* to *B* will be assumed. User at *A* turns the crank of his hand generator, which opens the automatic switch shown as a part of the generator. Current flows from the generator of station *A* upward, through the ringer of station *A*, to the top wire of the line, and has but one closed path, which is across the top line wire to station *B* and down through the ringer of station *B* and through the closed automatic switch of the generator of station *B*, thence to the left along the lower line wire and up to the generator of station *A*, passing to normal conditions of talking in Fig. 118, the user at station *A* takes his receiver from the hook to listen for the response of station *B*. The contacts of the hook switch of station *A* are closed.

A primary circuit thus is closed at station *A* comprising the battery, the transmitter, the primary or heavy wire of the induction coil, one of the contacts of the hook switch, the body of the hook lever, and the connecting wiring. A continuous current flows in this primary circuit, generated by the battery, and when the transmitter is spoken into an alternating potential is created in the secondary of the induction coil.

After station *B* has answered, a circuit for the secondary winding of the induction coil will be formed, as follows: From the secondary of the induction coil of *A*, through the receiver of *A*, to the upper line wire, thence to the right to station *B*, thence through the receiver and secondary of the induction coil of station *B*, through the closed contact and hook lever of the hookswitch at *B*, returning over the lower line wire and upward through the closed hook switch of *A* to the secondary winding of the induction coil, completing the circuit. The same secondary circuit is used when the transmitter of station *B* is spoken into. Thus either transmitter causes a current to flow over both line wires and through both receivers. The speaker talks to his own ear as well as to the ear of the distant hearer.

A circuit which has been specialized for party line conditions is shown in Fig. 119. This circuit may be studied particularly as an exercise in permutation reading of diagrams.

The sole difference between a telephone set in Fig. 118 and a telephone set in Fig. 119 is found in the connection ex-

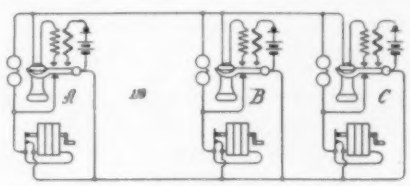


Fig. 119

tending from a point below the ringer and to the under contact point of the switch hook.

Still another example for reading is given in Fig. 120, wherein a party line of three stations is represented. Biased bells, and pulsating generators are indicated by the polarity marks adjacent to the symbols for ringers and generators. Taking the direction of current as proceeding from plus sign to minus sign, pulsating current suitable for ringing biased bells will flow from the plus side of any of the generators, out upon the line and through such circuits as can be found, returning to the minus side of the same generator. In the matter of the ringers, current is free to flow through the ringer in either direction, but the armature will respond and the ringer will be rung only when the current comes in at the terminal marked plus and leaves the ringer at the terminal marked minus.

The solution for the circuit of Fig. 120 is: Head station *A* may call either sub-station *B* or sub-station *C;* the station *B* may call head station *A;* the station *C* may call head station *A;* but station *B* may not call station C.

To confirm the study of the circuit of Fig 120, it may be fitted to the present practice of telephony in two ways. First, the line may be a party line, with the station *A* the central office, so that either of the stations *B* or *C*, may call the central office without announcing the call to the other station of the line. This is called "silent signaling" and is a desirable feature in party-line operation. Second, the line may be a toll line owned by a party at station *A*. In this case he has arranged the line so that *B* cannot call *C*, nor vice versa, but *B* must call *A* and ask *A* to call *C*. Thus a call cannot be made without the knowledge of station *A*, and this knowledge on the part of that station enables the owner of the line always to make a charge for any conversation between station *B* and station *C*.

To Be Continued.

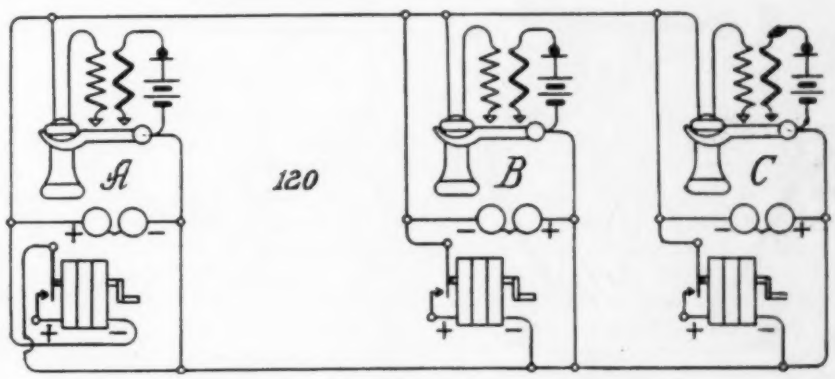


Fig. 120

Unique Mfg. Co. Moves Into New Factory

Chicago, Ill.—Unique Mfg. Co., makers of blow torches and furnaces that are widely used in telephone work, has moved into its new factory at 221 Whiting street, Chicago. Here Unique has a big daylight plant, and with the enlarged facilities and the great amount of new machinery installed when the company's most recent expansion took place, there is a considerable increase of production with a maintenance of the high standards of manufacturing upon which Unique has prided itself.

J. L. McQuarrie Elected International Vice President

New York City.—The International T. & T. corporation has elected James L. McQuarrie vice president and chief engineer. For the past 45 years, Mr. McQuarrie has been continuously engaged in engineering work relating to electrical communication. This entire period being spent with the Bell Telephone System, up to the purchase of the International Western Electric Co. by the International Telephone and Telegraph Corp., October 1, 1925.

LINE AND DESK

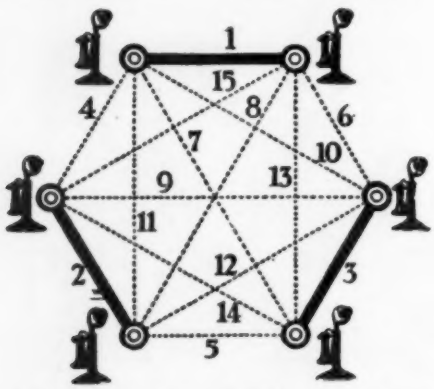
THE MATHEMATICS OF INCREASING SERVICE

Take a sheet of paper and make five dots on it. Draw lines connecting each dot with every other dot. There will be ten lines.

Now put one more dot on the paper. Connect it with each of the other dots. Then there will be fifteen lines. In this case one more dot means five more lines. If you add and connect still another dot, that will mean six more lines. An eighth dot adds seven lines. A ninth dot adds eight lines. And so on.

In a diagram the heavy lines show three segregated pairs of telephones which, of course, permit only three talkways. When they are connected through a modern switchboard the talkways are increased to fifteen. It will be seen that as an exchange grows the construction, maintenance and operating costs must increase.

If you had 9,999 dots and added another, that 10,000th dot would mean adding 9,999 lines if it were to be connected with every other dot. The number of different connections possible among these 10,000 dots reaches the stupendous total of 49,995,000. In Chicago with 813,000 telephones there are no fewer than 330,484,093,500, or over 330 billion, different talkways.



That's how telephone systems grow, and as an exchange grows the service becomes more valuable to each subscriber as the number of persons he can reach increases. Every time a telephone is added to the system it must be made possible to connect it with every other telephone. Of course, these connections are made through central office switchboards. But an inexorable mathematical law causes the number of possible connections to increase by leaps and bounds as the system grows. The bigger the system, the more complex it becomes. That is expensive for the telephone companies, but it is unavoidable.—*"Bell Telephone News."*

ELIMINATING RADIO INTERFERENCE CAUSED BY LEICH 7-A FREQUENCY CONVERTER

Having a Leich 7-A frequency convertor which gave considerable trouble on the radio we tried a number of schemes of eliminating this interference and found the following layout to be very successful:

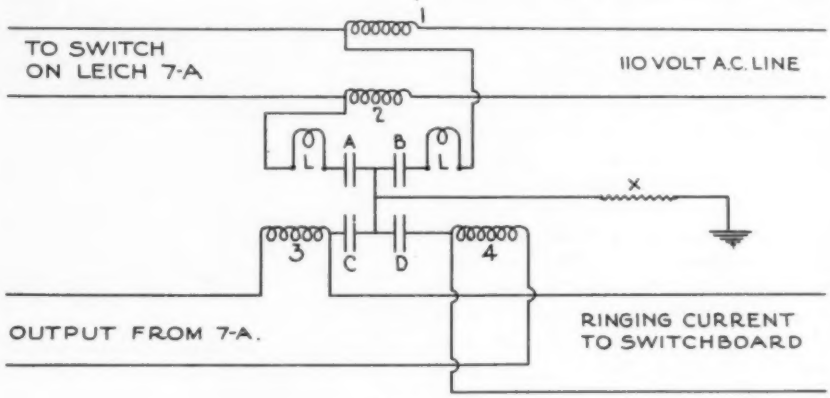


Fig. 1

The wiring diagram is in Fig. 1.

The coils 1-2-3-4 are 1600 ohm ringer spools wound full of No. 22 copper magnet wire, either single or double cotton or silk insulation may be used, one pound being required to wind the four spools.

The condensers A-B-C-D are two M. F. telephone condensers and L are two 25 watt Mazda lamps. The apparatus may be mounted on a base board or in a box to suit the builder.

At the point X we inserted a one quarter ampere fuse as a protective measure.

This arrangement consumes a very small amount of current which can be further reduced by using one M. F. condenser in place of the two M. F. but in our case the two M. F. proved the most successful.

The wire leading to ground should be as short as possible and should not be connected to the switchboard or main frame ground but to a separate ground. —Contributed by *A. W. Nicolay.*

DON'T BE A "FLAT TIRE"

Lack of personal interest in your division or department indicates a similar lack in everything pertaining to your work, except possibly the pay check you receive for what you should do.

The man who skates along by himself, self-centered and aloof from the crowd, usually sinks alone and unmourned when the ice breaks.

A barrel requires bonds to keep the staves in place and without the proper bonds the purpose of the barrel cannot be served.

Just for example consider that you and your fellow workers form a barrel of work held together by hoops of system, mutual interest in the work, good feeling, interest in the welfare of all concerned and a desire to pull together in making for the proper working out of all problems.

Take away one hoop and the others are gradually weakened; put additional strength in one and others are strengthened.

One of the most important bonds is that made up of good fellowship and a willingness to help one another.

In other words shed grouches like a duck's back sheds water, give animosity no place in your makeup, take an interest in activities to promote closer bonds with your associates and avoid becoming a "flat tire" through a little more steady application of the Golden Rule.

Be one of the bunch, put yourself out a little once in a while to help others, then watch your efforts result in a better understanding and a more closely bonded and progressive organization.—F. O. Proctor in Bell Telephone News.

HAD HIS YARD FULL OF GROUND RODS

Reading our answer to a query relative to ground connections in last month's

issue, where two separate grounds were required to prevent cross talk and cross ringing, reminded one of our "peddler" friends of a condition he found in one of our southerly states. It seems that he was making the first trip over his territory for he tells of locating the house in which the exchange was located and, on approaching it, noticing a forest of ground rods in the yard and a large bundle of wires running from the house to the rods. Upon inquiring of the man who looked after the exchange he found that each line that came into the office had its own ground connection entirely separate from all the other lines. "It's always worked just fine, too," said the local trouble hunter.

A HANDY KEY CABINET LAY-OUT

In the average exchange there are many locations where a subscriber's requirements are such that one telephone with one or more extensions will not handle all calls without serious delays which makes two or more lines desirable. Usually it is necessary to have all numbers listed under the firms name and not individuals. Trouble is then experienced by parties calling an individual on one line that can be reached only on some other phone. Transfering calls from one line to another is annoying and slows up the service. In cases of this kind an arrangement of keying the lines together as indicated in Fig. 1, will be found useful. One key is necessary at each telephone in order that the instrument can be switched to either line. Keys for this purpose mounted in a neat case can be purchased or suitable ones can be made up from old parts picked up around the average storeroom. The bells can be connected to the lines at separate locations in the room or can be toned so that they can be distinguished. Several phones with keys can be connected to the lines if desired and one clerk designated to answer incoming calls and notify the desired party by means of a push button and buzzer. If two lines are not sufficient for the volume of traffic three lines with three position keys can be used, but usually the two line arrangement is to be preferred. If three lines must be used it is best to have two lines incoming with bells, and one line without bell for outgoing service. As the bells in the Sub-sets are not used a cheap set without bell can be made up as indicated in Fig. 2. The regular desk stand is used by connecting it to a sub-set made up of five binding posts, a condenser and an induction coil mounted on a small base board. This arrangement will give service equivalent to a small PBX, but eliminates much of the expense and the operator.—*Ray Blain.*

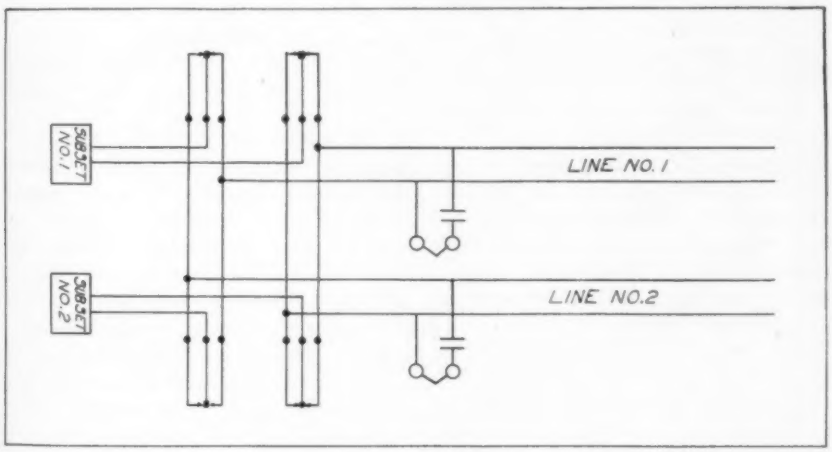


Fig. 1

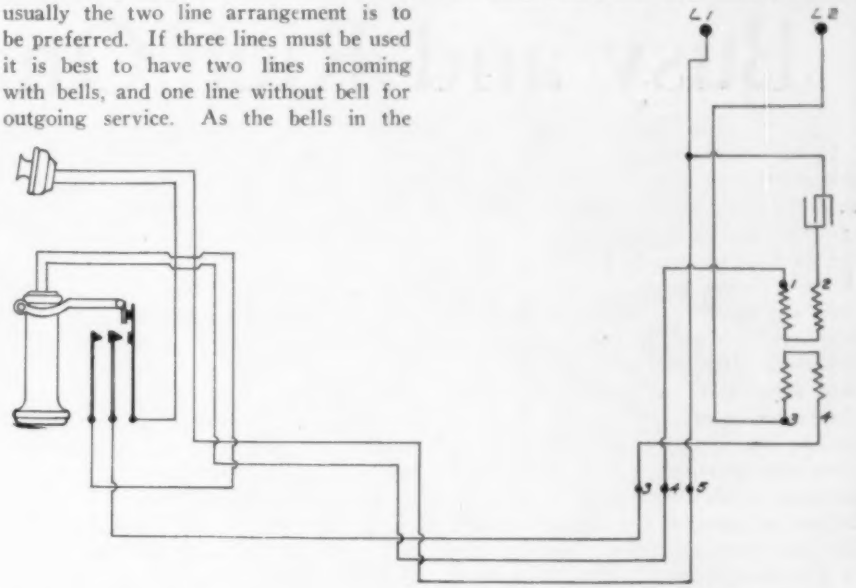


Fig. 2

Hubbard and Company Holds Third Annual Sales Conference

Pittsburgh, Pa.—The electrical materials department of Hubbard and Company held their third annual sales conference at Webster hall, Pittsburgh, Pa. The meeting was attended by all the company's salesmen, district managers and three plant managers.

At this meeting the sales and advertising program for 1927 was discussed and a complete territorial analysis was given by each salesman of the organization.

Selling talks by sales managers of several large manufacturing concerns were also featured and were appreciated by the entire organization.

The Hubbard sales force includes: C. L. Peirce, Jr., general manager; W. R. Pounder, manager, Chicago plant; J. V. Smith, manager, Oakland plant; N. C. Husted, manager, Niles plant; W. M. Heim, assistant manager; F. E. Norman, manager of Peirce Specialties Sales; A. R. Robitzek, manager of Hardware sales; R. G. Robbins, advertising manager; E. Wessel, district manager; F. E. Wright, district manager; F. W. Ashley, sales engineer; R. O. Barnes, sales engineer; V. H. Cutler, sales engineer; M. M. Johnson, sales engineer, C. H. Keen, sales engineer; A. McIlrath, sales engineer; H. H. Manny, sales engineer; J. P. Spicer, sales engineer; R. M. Waggoner, sales engineer; S. B. Webb, sales engineer and I. F. Wilder, sales engineer.

WHO WILL GIVE MR. VANCUREN THIS ADDRESS?

Telephone Engineer, Chicago: Will you kindly advise if you know of any company who makes a wire, take-up reel to bolt or fasten to the rear wheel of a Ford car to take up No. 9 and No. 12 iron wire.—B. F. Vancuren, Pres., Vancuren Telo. Co., Hammond, Ill.

A. Terk Handling Northern California Affairs

San Francisco, Cal.—A. Terk has been named as temporary representative of the California Independent Telephone association to handle the affairs of the association in the northern part of the state. He will work in connection with the secretary of the association. Mr. Terkle's address is 886 Mills Bldg., San Francisco.

Semi-Centennial Year Was Busy and Rich One for Bell

In his annual report to stockholders, released on March 2nd, President Walter S. Gifford reports the substantial progress that has been made toward reaching the ideal and aim of the Bell System. After referring briefly to the fact that 1926 was the fiftieth anniversary of the telephone and quoting Dr. Bell's words indicating a nation-wide ideal, Mr. Gifford restates the ideal and aim of the system as "a telephone service for the nation; free, so far as humanly possible, from imperfections, errors or delays, and enabling at all times anyone anywhere to pick up a telephone and talk to anyone else, anywhere else, clearly, quickly and at a reasonable cost." The progress made in 1926 is then recounted in the report.

Statistics Show Progress Made in 1926.

There were 781,000 telephones added to the number owned and operated by the System.

The total number of telephones in the United States interconnected in and with the System at the end of the year was 17,574,000.

There has been definite improvement in local exchange service. The number of exchange plant troubles per unit of plant was reduced 17 per cent.

The average time from the receipt of requests for the installation of telephones to the completion of such installation was reduced by one day. Including telephones installed in new locations on account of subscribers' moves, more than 3,800,000 installations were made.

There is, inevitably, some demand for telephone installation in outlying sections that cannot be met immediately. The number of such cases that were waiting for service was reduced 50 per cent.

More than 664,000 miles of toll wire were added during the year, this being the largest number of miles added in any one year.

An additional transcontinental telephone line was completed to the Pacific Coast in 1926, making a total of three such lines now in operation. The new line terminates at Seattle. It will make possible better and faster long-distance telephone service to the Pacific northwest. It also adds to the dependability of the transcontinental service, for it is unlikely that any storm would interrupt service on all three lines at once.

The toll cable between New York and Chicago which was completed in 1925 has been extended to St. Louis, and further extensions of toll cable plant are under way. This use of long cables in place of open wires further insures the dependability of long-distance service. Today over 60 per cent of toll and long-distance telephone calls are handled through cables.

Improvements and New Features Introduced During Year.

The average length of time for completing toll calls for the whole System during the year, including both toll calls completed by local operators and those handled at separate toll boards, was two minutes per call, the lowest for any year by 35 seconds.

The quality of voice transmission was practically perfect in 88 per cent of toll calls, an improvement of 7 per cent over the previous year.

During 1926 an adjustment in long-distance rates was made by the American Telephone & Telegraph Co. amounting to a reduction of about $3,000,000 annually.

On January 7, 1927, regular commercial transoceanic radio telephone service was inaugurated between New York and London, a most important step forward in the art of telephone communication, the ultimate results of which no one can foresee.

The service for the transmission of pictures by wire inaugurated in 1925 has been extended to Boston, Cleveland, St. Louis, Atlanta and Los Angeles, so that this service is now commercially available between these cities in addition to New York, Chicago and San Francisco.

While somewhat aside from telephone service, interesting developments of the Bell Telephone Laboratories, Inc., which have grown out of their research and development in the telephone art, have resulted in the successful inauguration of talking moving pictures, and in further improvement in the efficiency and economy of submarine telegraph cables.

Organization Which Functions with Clock-Like Precision.

Referring to the form of the organization, a group of regional operating companies tied together by the wires of the American Telephone & Telegraph Co., Mr. Gifford points out their analogy in form of organization to that of the national government.

Although the telephone was one of the greatest inventions of an age of large fortunes, the inventor and the original backers never made a great fortune from it—in fact, says Mr. Gifford, there are not any "telephone fortunes." For over forty years no individual or small group has owned a controlling interest in or even a relatively substantial part of the stock of the American Telephone & Telegraph Co. (or its predecessor the American Bell Telephone Co.). That an organization with such large and widespread ownership and with a management actuated by a sense of trusteeship can progress along right lines, and has made progress, is evidenced by the record. It is in keeping with our democratic ideals and institutions and in a very real sense in a reflex and an expression of them. Widespread ownership permits, and in fact obliges, management to make its decisions with a long look ahead rather than for the possible temporary advantages of the moment. Obviously, in the case of the American Telephone & Telegraph Co., sound business dictates that the continuing aim shall be to improve service in its broadest sense and to furnish that service at the lowest possible cost.

And Here Are the Figures on Finances.

Mr. Gifford's report on the financial status of the Bell System as a whole says:

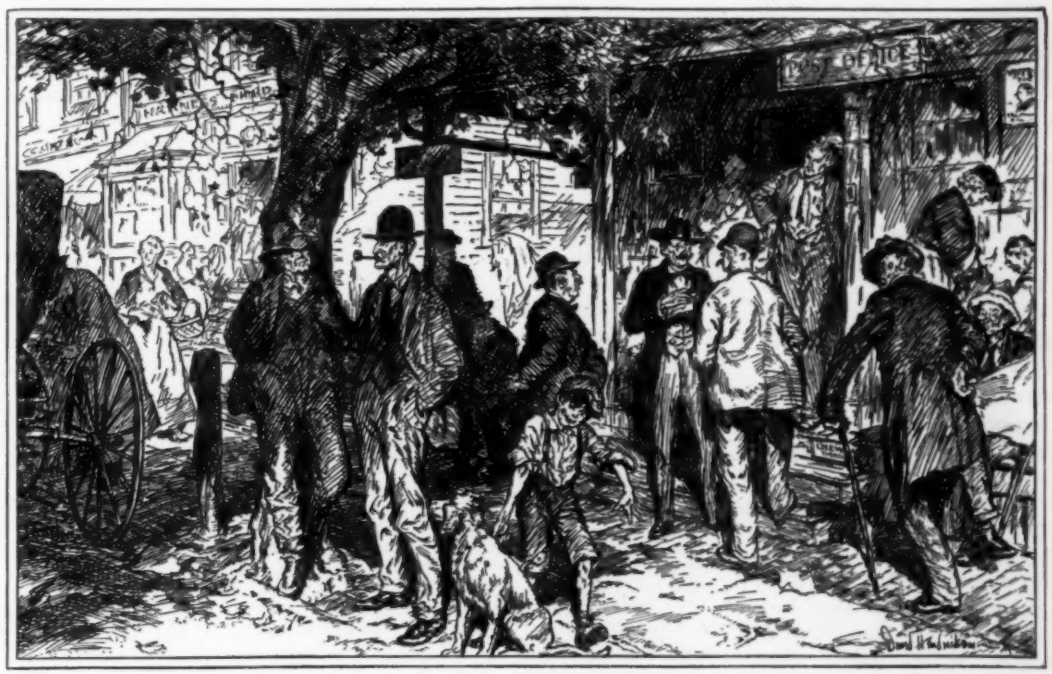
The investment of the American Telephone & Telegraph Co. and its 24 associated operating telephone companies which comprise the Bell Telephone System increased over $318,000,000 during the year, and total assets were over $3,256,000,000 at the end of the year.

The Bell Telephone System net earnings in 1926 were $204,870,000, an increase of $22,426,000, or 12 per cent over the previous year. This compares with an increase in investment of 11 per cent. These net earnings were at the rate of 6.6 per cent on the amount invested in plant and other assets.

At the end of the year the System had $46,688,000 in cash to meet current expenditures, and temporary cash investments of $93,224,000 held available for conversion into cash as needed.

The facts which this report gives about the stockholders of the American Telephone & Telegraph Co. are striking proof of the tendency for widespread ownership of American corporations.

With 399,121 stockholders at the end of the year, the American Telephone & Telegraph Co. doubtless has the largest number of stockholders of any corporation in the world. The net gain in stockholders during the year has been 36,942, which is larger than the gain in 1925. The average number of shares held per



The Meeting Place

An Advertisement of
the American Telephone and Telegraph Company

It is not so long ago since people met in town hall, store or at the village post-office, to talk over matters of importance to the community. Then came the telephone to enable men to discuss matters with one another without leaving their homes.

With the growing use of the telephone, new difficulties arose and improvements had to be sought. Many of the improvements concerned the physical telephone plant. Many of them had to do with the means of using the apparatus to speed the connection and enable people to talk more easily.

This need for improvement is continuous and, more than ever, is a problem today. Speed and accuracy in completing seventy million calls daily depends upon the efficiency of Bell System employees and equipment as well as upon the co-operation of persons calling and those called and numerous private operators.

It is not enough that the average connection is made in a fraction of a minute or that the number of errors has been reduced to a very small percentage.

The American Telephone and Telegraph Company and its associated Bell Telephone Laboratories have practically for their sole task the making of the telephone more serviceable and more satisfactory—as a means of conversing with anyone, anywhere, any time.

stockholder is now 26.6. No shareholder owns as much as one per cent of the total stock outstanding.

The Plant Also Presents Some Interesting Figures.

The telephone plant and equipment of the Bell System increased $262,625,000 during the year. At the end of the year 1,975,000 telephones, or 15 per cent of the total, were served by machine-switching central offices. As an example of the work of development and research, part of which is carried on in the Bell Telephone Laboratories, is cited the development of contact metal to replace platinum in the hundreds of millions of telephone contacts that function billions of times daily. A saving of $9,000,000 annually and improved efficiency have been the result of this work of which the general public is quite unaware.

Pleasant Relations with Customers an Important Item.

Mr. Gifford says that every effort is being made to maintain a sympathetic understanding with subscribers as well as to further improve the technical features of telephone service. In spite of the complexity of the problem, progress has been made during the past year and it is the aim of the System to eliminate, so far as possible, all sources of error and irritation, and to place the relation of the telephone user and the company on a basis by which the individual receives the best possible telephone service and at the same time the personal attention which he very properly desires. The work of the general relief and thrift program of the system through its employes' benefit, stock purchase and savings plans is discussed briefly in closing the report.

Bell System Financial Statements.

The Bell System balance sheet and income statement which follow consolidate the accounts of the American Telephone & Telegraph Co. and its twenty-four associated operating telephone companies, all inter-company duplications being excluded from the combined figures. The accounts of the Western Electric Co., the Bell Telephone Co. of Canada and of subsidiary and connecting companies in which either the American Telephone & Telegraph Co. or its associated telephone companies have investments are not consolidated. The investments in these companies are included in the accompanying balance sheet under the item "investments,' and dividends and interest received from them are included in the income statement under "non-operating revenues."

Bell System Balance Sheet, December 31, 1926.

(Inter-company duplications excluded.)

ASSETS.

Telephone plant	$2,783,023,059
General equipment, tools and supplies	73,841,666
Investments	168,708,432
Receivables	91,150,292
Temporary cash investments	93,224,121
Cash	46,688,540
Total assets	$3,256,636,110

LIABILITIES.

Capital stock (including installments)	$1,312,881,184
Funded debt	921,523,000
Bills payable	863,075
Accounts payable	57,043,236
Accrued liabilties not due	88,823,683
Employes' benefit funds	35,519,438
Surplus and reserves	839,982,494
Total liabilities	$3,256,636,110

Bell System Income Statement for Year Ending December 31, 1926

(Inter-company duplications excluded.)

Exchange revenues	$ 557,489,795
Toll revenues	248,086,768
Miscellaneous revenues	17,640,172
Total operating revenues	$ 823,216,735
Current maintenance	$ 125,798,424
Depreciation expense	127,605,695
Traffic expenses	197,653,650
Commercial expenses	71,362,726
General and miscellaneous expenses	32,419,840
Total operating expenses	$ 554,840,335
Net operating revenues	$ 268,376,400
Uncollectable revenues	$ 5,289,008
Taxes	69,688,202
Operating income	$ 193,399,190
Non-operating revenues—net	21,329,492
Total gross income	$ 214,728,682
Rents and miscellaneous deductions	$ 9,858,333
Net earnings available for interest, dividends and appropriations of income	$ 204,870,349
Interest deductions	$ 49,809,330
Net income	$ 155,061,019
Dividends	$ 100,614,437
Miscellaneous appropriations of income	$ 5,048,000
Balance	$ 49,398,582

Security Issues of Bell System Companies Outstanding in Hands of Public

Common Stock (Including Installments)	Par value.
American Telephone and Telegraph Co.	$1,112,796,679
New England Telephone and Telegraph Co.	42,057,000
Southern New England Telephone Co.	18,663,900
Cincinnati and Suburban Bell Telephone Co.	12,882,100
Mountain States Telephone and Telegraph Co.	10,449,700
Pacific Telephone and Telegraph Co.	4,861,200
Illinois Bell Telephone Co.	785,500
Other Associated Companies	15,893
Total common stock	$1,202,511,972

Preferred Stock (Including Installments)	Par value.
New York Telephone Co. 6½%	$ 25,000,000
Bell Telephone Co. of Pennsylvania 6½%	20,000,000
Diamond State Telephone Co. 6½%	494,500
Chesapeake and Potomac Telephone Co. of Baltimore City 7%	3,000,000
Ohio Bell Telephone Co. 7%	12,745,847
Wisconsin Telephone Co. 7%	4,947,000
Northwestern Bell Telephone Co. 6½%	4,439,565
Southwestern Bell Telephone Co. 7%	21,785,000
Pacific Telephone and Telegraph Co. 6%	17,957,300
Total preferred stock	$ 110,369,212
Total capital stock	$1,312,881,184

Funded Debt (a)	Face value.
American Telephone and Telegraph Co.	
Collateral Trust 4s, 1929	$ 77,901,000
Collateral Trust 5s, 1932 of Western Tel. & Tel. Co.	9,969,000
Collateral Trust 5s, 1946	71,665,900
Debenture 5s, 1960	123,085,400
Debenture 5½s, 1943	97,848,700
Convertible 4s, 1936 (b)	2,581,000
Convertible 4½s, 1933 (b)	1,899,400
New England Telephone and Telegraph Co.:	
Debenture 5s, 1932 (c)	9,991,000
First Mortgage Series A 5s, 1952	35,000,000
First Mortgage Series B 4½s, 1961	39,945,000
New York Telephone Co.:	
First and General Mortgage 4½s, 1939	61,813,345
Refunding Mortgage Series A 6s, 1941	49,659,000
Debenture 6s, 1949 (c)	21,884,100
Bell Telephone Company of Pennsylvania:	
First Mtg. 5s, 1943, of The Central District Telephone Co.	9,339,500

First and Refunding Mortgage 5s, 1948.....	35,000,000
First and Refunding Mortgage 5s, 1960.....	50,000,000
Southern Bell Telephone and Telegraph Co.:	
First and Gen. Mtg. 5s, 1937, of Cumberland Tel. & Tel. Co.....	14,969,000
First Mortgage 5s, 1941..	15,561,500
Ohio Bell Telephone Co.:	
Consolidated 5s, 1944, of The Ohio State Tel. Co.	5,422,000
Illinois Bell Telephone Co.:	
First and Refunding Mortgage 5s, 1956.....	48,976,200
Southwestern Bell Telephone Co.:	
First and Refunding Mortgage 5s, 1954.....	49,238,600
Pacific Telephone and Telegraph Co.:	
First Mortgage and Collateral Trust 5s, 1937....	29,955,000
First and Ref. Mtg. 5s, 1947, of So. California Telephone Co.	6,028,000
Refunding Mortgage 5s, 1952	24,044,000
Minor bond issues (34 in number) of associated companies	27,531,130
Real estate mortgages of associated companies	2,215,225
Total funded debt.....$	921,523,000

(a) Includes issues assumed or guaranteed by Bell System Companies.
(b) Conversion privilege expired.
(c) Now secured by mortgage.

Stromberg-Carlson Issues 1927 Catalog

Rochester, N. Y.—Stromberg-Carlson Telephone Mfg. Co. has issued its new catalog for 1927 which gives details of the construction and prices of the extensive line of Stromberg-Carlson equipment. Telephone instruments and switchboards are fully covered and considerable data is given on the interesting and popular line of Stromberg-Carlson's radio equipment and supplies.

New York Telephone Co. Will Spend Over $12,000,000.

New York City—The New York Telephone Co., Feb. 23, authorized the additional expenditure of $3,678,795 for new construction work, bringing the total appropriations made since the first of the year to $12,832,015, of which $10,354,085 is for enlargement of plant facilities in the metropolitan area.

Melbourne, Australia—Plans are almost completed for entire reorganization of the system here at a cost of approximately $5,000,000.

W. L. Jacoby New Kellogg President —J. B. Edwards Retires After 40 Years

Chicago, Ill.—A new president, W. L. Jacoby, heads the Kellogg Switchboard and Supply Co. Joseph G. Edwards, for 40 years an active factor in the telephone industry, retires from the Kellogg presidency to enjoy a well-earned rest. Mr. Edwards has contemplated taking things easy for some months, and when a successor was found in an industrial leader and financier of the Jacoby type, the new lineup was announced.

Mr. Jacoby has been vice-president of A. G. Becker and Co., a prominent Chicago financial house, for the past eight years and has been concerned in the operations, both in an advisory and executive capacity, of a number of important organizations while associated with the Becker institution.

W. L. Jacoby

J. B. Edwards

Graduating from Lehigh University as a mechanical engineer, Mr. Jacoby engaged in the steel business, principally with the Latrobe Steel Co. and the Latrobe Steel & Coupler Co. and the Inter-Ocean Steel Co. for a number of years.

He organized the Inter-Ocean company, designed and built its plant in cooperation with the eminent engineer, Julian Kennedy of Pittsburgh, and was its president up to the time of sale of the property to the Railway Steel Spring Co.

Later he was engaged in special engineering work for various outstanding individuals in the business world, and then became president of the Hewitt Motor Truck Co. and of the American District Telegraph Co. and its subsidiaries.

He left the latter company to become associated with A. G. Becker & Co.

J. B. Edwards, the retiring president, has been one of the leading figures in the Independent telephone manufacturing industry for over 25 years. For a number of years prior he was also connected with the Western Electric Co. in various important positions, and at one time was in charge of its Antwerp works in Belgium.

Joining the organization of the Kellogg Switchboard & Supply Co. later under Milo G. Kellogg, he became vice-president and general manager of the concern, and in 1916 was elected president, serving until this month when he voluntarily retired to be succeeded by Mr. Jacoby.

Mr. Edwards' ability as a manufacturer had much to do with the excellent reputation Kellogg apparatus has won in the telephone field, and under his management the company has become one of the leaders in the industry.

Mr. Edwards has served as a director of the United States Independent Telephone Association for many years, and is a member of its executive committee at the present time.

Quick Directory Service Business Grows

Indianapolis, Ind.—W. L. Griffith, manager of the Quick Directory Co., publishers of telephone directories, is witnessing a rapid growth of his business among telephone companies. Griffith goes after business on the basis of saving of worry, bother and expense for the Independent companies in the publication of directories and is meeting with a good response to his solicitation.

Trieste—Direct connections between Trieste and Prague are being built.

Matthews Features Slack Puller and Adjustable Reel

St. Louis, Mo.—Matthews Quick Release Slack Puller was designed primarily for pulling slack from conductor and guy wires, but there are many uses to which it can be put and in each case will prove itself a safe and economical tool says the maker. Matthews Slack Pullers occupy very little space and can therefore be used safely in very restricted places. The ratchet handle permits its use in extremely congested places. With the gear ratio supplied, one man can pull as much strain with the Matthews Slack Puller as four men can by using the regular block and tackle.

No slack is lost in dead ending as is the case when block and tackle is used because of the fact that it holds the strain to the exact point to which it has been pulled.

A new and exclusive quick release feature is now incorporated in Matthews Slack Pullers. When the entire take-up has been used, the wire is temporarily dead ended and the lock released. This permits the slack puller to be immediately extended to its maximum or any intervening length.

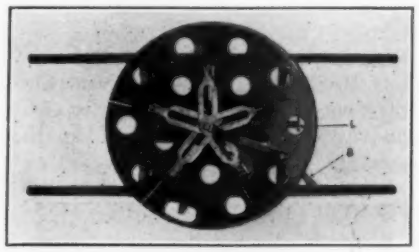
Matthews Slack Puller in Operation

The Matthews Slack Puller is now obtainable in two sizes: One of 3000 pounds maximum and one of 10,000 pounds maximum.

The Matthews Slack Puller is ruggedly constructed and will withstand severe service. The great economy effected, coupled with the relative ease and safety with which difficult jobs can be accomplished, make the Matthews Slack Puller an important adjunct for any line crew.

The Matthews corporation also is featuring Matthews Adjustable Reels which it states makes the handling of wire on coils extremely easy and far more easy than wire on wooden reels can be handled. The corporation says:

"The Matthews Adjustable Reel in addition to being ruggedly constructed has several distinctive features which make wire stringing or pulling out an economical, fast and safe procedure. Economy is effected by the fact that wire can be purchased in coils. The cost of wooden reels and their incident freight charge can be saved.



Matthews Adjustable Reel

Wire stringing or pulling is expedited with the Matthews Adjustable Reel. It is not necessary to pull wire down on to the road and then coil it up by hand as the pulling out and coiling on the reel can be done at the same time; therefore saving considerable time.

"Matthews Adjustable Reel affords safety to the reel attendant and to the other men working on the conductor being strung or pulled out due to the fact that the reel table is metal and can be grounded thereby affording safety to the men should the conductor accidentally come in contact with a live wire.

"The five arms can be quickly and easily contracted or expanded to fit the inside diameter of any coil of wire within its range. The revolving table is made of sheet steel reinforced by a turned over edge which prevents it from being bent out of shape. This edge also prevents the wire from getting caught under the table or cutting itself on the sharp edge (see figure 2 and 3 above).

"Matthews Adjustable Reel is supplied with or without a brake. The brake is recommended as it prevents racing when paying out wire."

Morrison and McDuffie in Southwest for American

Chicago, Ill.—February first the American Electric Company, Inc. added to its force two well known telephone men to represent them in the Southwest. F. E. Morrison was made representative in Kansas and R. D. McDuffie named representative in Oklahoma with headquarters at Oklahoma City.

F. E. Morrison entered the telephone field in 1900 with the American Independent Telephone company at Osage City, Kansas. In 1903, he went to the old M. & K. Telephone company, at Topeka. From 1906 to 1917 he was employed by the American Independent Telephone company at Holton, Kansas.

F. C. Morrison

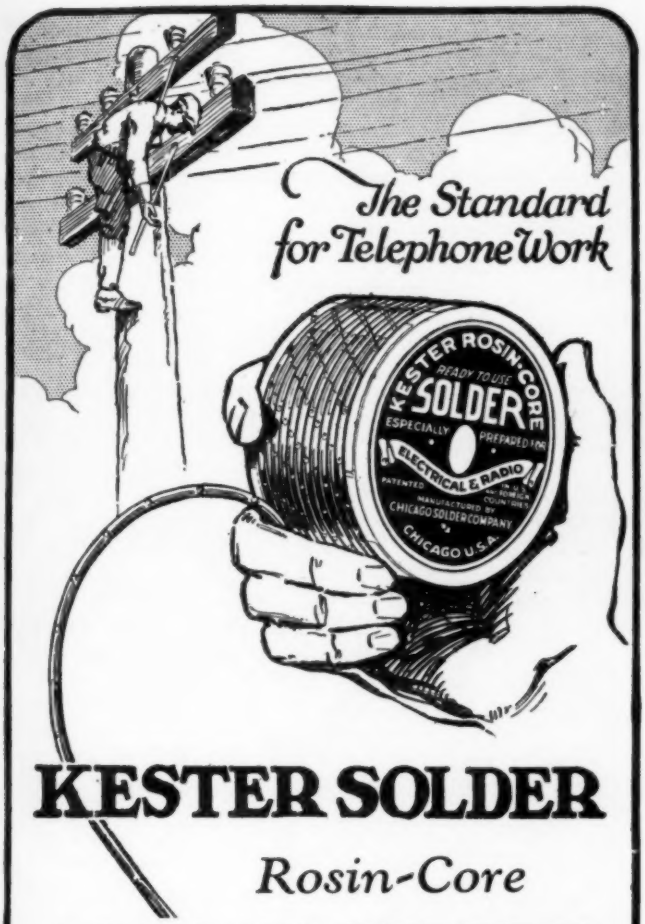
first as superintendent of plant and equipment and later as treasurer and general manager.

In 1917 Morrison entered the employ of the Kansas City Long Distance Telephone Company, at Kansas City, where he served until September, 1920, leaving at that time to represent the Kellogg in Missouri. He remained in their

D. D. McDuffie

service until he entered the employ of the American Electric.

R. D. McDuffie began his telephone work in 1906. He has worked from the ground up, having had experience with



The Standard for Telephone Work

KESTER SOLDER

Rosin-Core

In the telephone field Kester Solder is the standard for both maintenance and production work. The comprehensive line of Kester Solder embraces a range of sizes from approximately 1/4″ to 1/16″ in diameter. Standard Acid Core diameter, being 1/8″ and Standard Rosin Core diameter 3/32″. Packed on one, five, ten and twenty pound spools, there is a range of size and style of package suitable for every practical purpose.

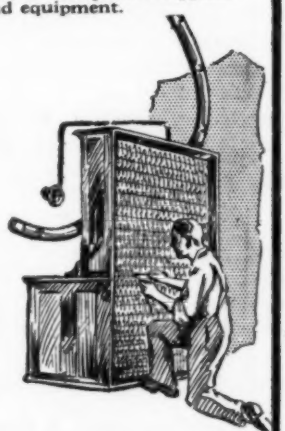
For heavier electrical work Kester Acid Core Solder can be used with considerable saving in time, labor and material.

For the more delicate electrical work on switchboards, etc., only Kester Rosin Core Solder should be used. Its pure rosin flux eliminates every danger of corroded work.

Most telephone companies specify Kester Rosin Core Solder No. 2, 50 core for cable line splicing as it not only conforms with the standard specifications, but also speeds up this class of work.

Kester Solder either rosin or acid core is handled practically everywhere by jobbers of telephone supplies and equipment.

We maintain a completely equipped research laboratory where we have solved soldering problems for many manufacturers. While our standard line of Kester Solder is adequate for practically every soldering job there are occasions where a specially developed solder and flux are required.



Consult our Research Engineer on your soldering problems

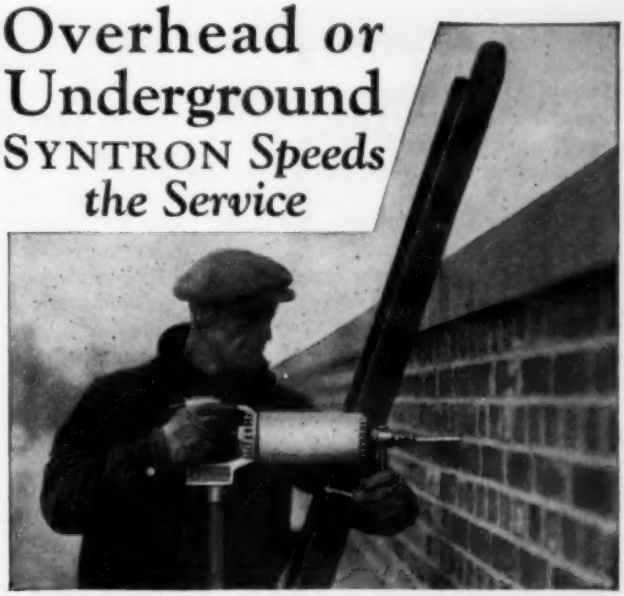
"Requires Only Heat"

CHICAGO SOLDER COMPANY

4218 Wrightwood Avenue Chicago, U. S. A.

Originators and world's largest manufacturers of Self Fluxing Solder

Overhead *or* Underground SYNTRON *Speeds the Service*



DRILLING holes to attach wire conduits, terminal boxes and cable clamps—house brackets—chipping for switch-boards—terminal and fuse boxes—channeling for conduits, pipe cables, etc., are only a few of the hundred jobs on which SYNTRON helps speed and maintain service.

SYNTRON

MOTORLESS ELECTRIC HAMMER

Strikes 3600 blows and drills 3″ into concrete a minute. Chips and channels as fast as ten men. Has no motor or gears to get out of order. Works from any light socket. Easy to operate. One man carries outfit about. Pays for itself in the first 40 hours' use.

Also SYNTRON Heavy Duty Hammers, with Power Plant

MAIL THIS COUPON

SYNTRON COMPANY

400 Lexington Ave., Pittsburgh, Pa.

Prove to us how Syntron will save 90% in labor and cost for us. Also how it pays for itself in 40 hours.

Name .....

Firm .....

Address .....

Business .....

telephone companies both as an operator an owner of telephone companies in Nebraska and Kansas.

During the war he entered the signal corps, and was afterwards transferred to the air service and was sent to Dorr Field, Arcadia, Fla., where he had general charge of the telephone plants and electric plants at both Dorr field and Carlstrom field.

On his discharge from the army he entered the employ of the Kellogg Switchboard & Supply Company, as representative working out of the Kansas City branch, in Kansas, Nebraska, Arkansas and Missouri. On February 1st, he entered the field for American Electric.

Both men have had a wide and varied telephone experience that will enable them to help solve the many problems of the operating man.

White Company Slashes Light Truck Prices

Cleveland, Ohio.—Development of a program planned for some time, resulting in The White Company's recent reductions in prices of two truck models, has been marked by a broadening of merchandising policy and expansion of White truck transportation into new and wider low price fields of light delivery.

Factory production schedules have been speeded up to meet the demand for quality trucks at lower prices. The new White policy has placed these high-grade trucks within the reach of all lines of business, providing a complete range of truck capacities and price.

The two light delivery models affected by price reductions—$605 in one and $825 in the other—are the Model 15 and Model 20. The former, with three quarter ton to one ton capacity, was reduced from $2,150 to $1,545, and the latter, with one and a half tons capacity, from $2,950 to $2,125, both in effect February 25.

"The commercial vehicle market," says President Walter C. White, "divides itself naturally into four classes—heavy duty, express, light delivery and busses. It has been The White Company's policy to develop its product in order to meet as fully as possible the demands in these various lines and the changes in traffic conditions which are constantly arising.

"Latest developments apply to the light duty fields. It seemed advisable to revise prices on the two light capacity truck models so that they would be on a more nearly competitive price basis in these fields and yet keep the high standard of quality. Increased volume which we anticipate would not alone give us sufficient reductions, but increased volume together with narrower margin for merchandising which maintains in this field enables us to lower and reach a new and larger class of buyers. There is no change in quality construction, standard specifications and balanced engineering of any truck or bus in the White line."

Texas Lays Plans for Record Convention

Fort Worth, Tex.—March 15-18 the Texas Telephone Association will hold what the association executives confidently believe will be the greatest convention in the state's telephone history.

The schedule of speakers includes a number of headliners:

Among those speaking at the general sessions will be Lon A. Smith, of Austin, a member of the Texas Railroad Commission who will speak Tuesday afternoon.

J. B. Earle, of Waco, on Tuesday afternoon will speak on "State Regulation of the Telephone vs. Self Regulation." Judge S. A. Lindsay, of Tyler, president, Gulf States Telephone Co., will discuss "Telephone Consolidations and the Effect."

At the general session on Wednesday, R. S. Manley, president Texas Creosoting Co., Orange, will present an illustrated talk on wood preserving.

R. W. Hedrick, Jefferson City, Mo., secretary, Missouri Telephone Association, will be another of the Wednesday morning speakers.

On Wednesday afternoon, George W. Robinson, president, Tri-State Telephone & Telegraph Co., St. Paul, Minn., and vice-president, United States Independent Telephone Association, will discuss the recent depreciation order of the Interstate Commerce Commission.

E. C. Blomeyer, Kansas City, Mo., chairman of the board, Diversified Investments, Inc., will speak on "Telephone Financing."

There will be a traffic conference in charge of Chairman Sam H. Shutt, of Waco, Earl R. Evans, of Waco, and Oscar Burton of Tyler.

Central Iowa Buys Eldora Company

Traer, Ia.—R. L. Parker, general manager of the Central Iowa Telephone company, has purchased the Eldora Telephone company for the Central Iowa organization. About 1300 stations are involved in the deal.

Jas. K. Hill New Page and Hill Kansas City Chief

Kansas City, Mo.—James K. Hill has been made district manager at Kansas City for Page and Hill company, cedar pole producers, of Minneapolis. He will have charge of the southwest territory.

New York City.—Platinum, gold and silver used for telephone contacts are estimated to have saved the industry about $30,000,000 in the last 12 years.

The Telephone Business for Telephone Men

WE firmly believe in the Protective Measures advocated by the United States Independent Telephone Association and the various State Associations, with respect to Telephone Financing.

***Along these conservative lines only*—we are interested in assisting Telephone Companies in connection with Mergers and Refinancing.**

Our advisory-engineering, report and valuation service is directed by Mr. Charles W. McKay, a Consulting Telephone Engineer of over twenty years' experience.

We invite correspondence with respect to your own individual problems.

White, Weld & Co.

Public Utility Bankers for 25 Years

134 South La Salle Street

NEW YORK CHICAGO BOSTON

Announcing—
the Highway Earth Boring Machine
Bores the Hole--Sets the Pole
A pole in the ground every five and one-half minutes is the record recently made on new line construction—under actual operating conditions. A three-man crew with the Highway Earth Boring Machine and Pole Setter bores the holes, sets the poles and moves from position to position all in this remarkable time. A saving of 75% of the time required for the same work by any other method.
The machine mounted on a Fordson or International Harvester tractor, equipped with crawlers, negotiates steep grades and swamps and easily reaches ninety percent of all locations.
Write for complete information
HIGHWAY TRAILER COMPANY
EDGERTON, WISCONSIN

Over Half a Million in Use

Vacuum Grip
REG. U.S. PAT. OFFICE
PLIERS

Lineman's Pattern No. 58, 8½ in. $3.50. Also furnished in 6 and 7 in.

Your Name Etched FREE on Handle

Pliers Must Be Stronger Today!

PLIERS have to be mighty good these days to stand the "gaff." Correct design, cutting ability, easy-working joints, etc., are not enough. They must have sheer "brute strength."

When you go after a tough job of twisting, gripping, cutting or hammering, or when you drop them from a pole, you expect them to do their work—without breaking.

We believe VACUUM GRIP Pliers will give you a new idea of plier strength. Of course, they're forged from electric furnace tool steel, hardened and tempered thru and thru, NOT Case-hardened. But the thing you are interested in is what they will do for *you*.

A running test will answer that question. Let us send you a pair or two for trial. If you are not pleased with them the purchase price will be refunded.

VACUUM GRIP Pliers are Guaranteed to give absolute satisfaction to the user, or full replacement or refund of purchase price will be made

Write for Catalog T-3 describing over 35 sizes and patterns, including special designs for repairmen and switchboard use, from which to select samples for trial.

PURCHASING AGENTS: Send for samples for your men to test

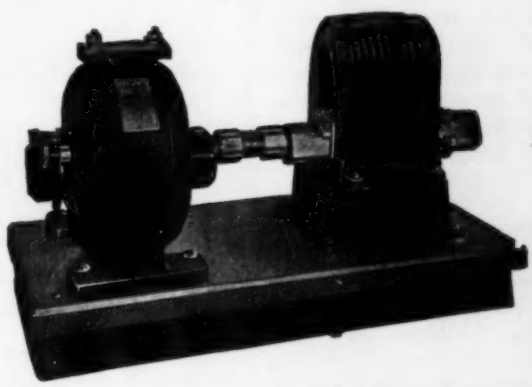
FORGED STEEL PRODUCTS CO., Newport, Penna.

For Maximum Service—Baker Contact Points

DEPENDABILITY and long life are the two essentials in a contact point. This "heart of the machine" should function evenly and steadily over long periods of time—it should not need replacement at frequent intervals.

Baker Contact Points are made with this principle always in mind and the name "Baker" assures that perfect performance, without constant renewal, which is the outstanding characteristic of a *good* contact point. Our contacts are made of Platinum, Iridio-Platinum, Silver and Special Alloys. There are sizes and types for all purposes.

BAKER & CO., INC.
54 Austin St., Newark, N. J.
NEW YORK CHICAGO



Radio and Ringing Troubles

The Holtzer-Cabot Magneto-Ringing-Motor-Generator **does not** cause radio disturbance, and gives 100% ringing service.

Do away with old methods and bring your exchange up to date.

A Holtzer-Cabot Magneto-Ringing-Motor-Generator will reduce your ringing costs and perfect your service.

Give this machine a THOROUGH test in your exchange. We stand back of all our products.

The Holtzer-Cabot Electric Co.
125 Amory St., Boston, Mass.
6161 So. State St., Chicago, Ill.

Lincoln Entertains and Instructs Civic Bodies

Lincoln, Neb.—The Lincoln T. & T. company, has just completed a series of programs and demonstrations held in their general office building. Due to the development and expansion of the business the company has been forced to provide larger general office quarters and has done so by adding a fourth story to the general office building.

The engineering department and the auditing department have entered their new office quarters on this fourth floor and in so doing vacated rooms which will be remodeled and occupied by the commercial, plant and traffic departments. The remodeling of the former auditing department quarters has been held in abeyance to give opportunity for the program of entertainment and demonstration for all of the civic and trade organizations in the city of Lincoln.

On Wednesday, December 29th, the Optimist Club and the Real Estate Board were entertained. Other civic clubs and trade organizations were entertained on following days, the entire series of programs ending on Saturday, January 8th. Other clubs entertained were as follows:

Adveristing club, 40 & 8 club, Cosmopolitan club, Lions club, Rotary club, Knife & Fork club, Retail Credit Men, Wholesale Credit Men, Axis club, Business Women's League.

In addition to the above clubs from Lincoln the business men's clubs of the suburban towns, Havelock, University Place and College View, were also entertained. The Board of Education of Lincoln and the Faculty of the Lincoln high school were also entertained.

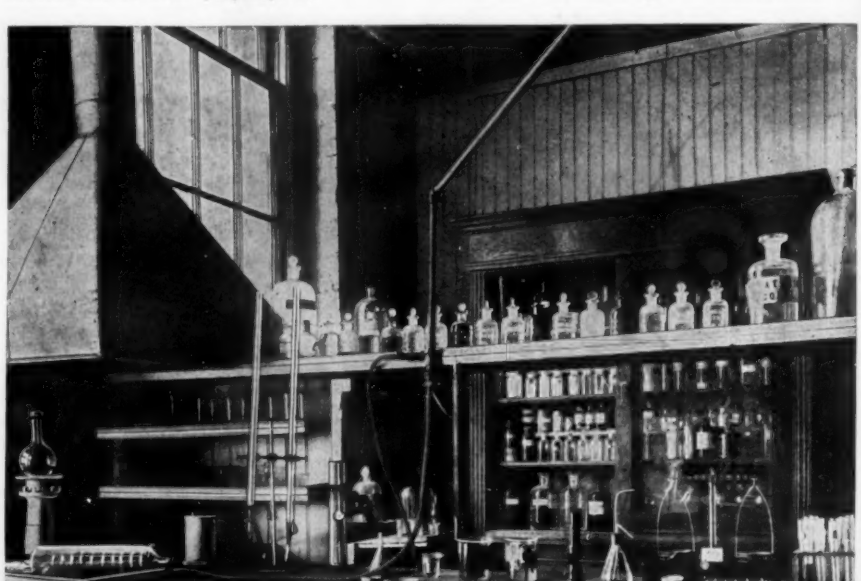
A total of 1,500 business and professional men and women were visitors during the series of programs. The program consisted of a luncheon served by telephone company employes and in the central office building. Following the luncheon short talks were given by President Frank H. Woods, Vice President Thomas C. Woods, and General Manager John H. Agee. Following the talks the visitors were shown a reel of telephone movies, after which they were conducted on a trip of inspection throughout the general office building.

Report of Southern New England Telephone Co.

New Haven, Conn.—A net increase of 17,842 stations or 7.1 per cent is shown by the annual report of the Southern New England Telephone Co., which operates in Connecticut. The development is, now, 18.4 telephones for each 100 of population. Local calls were estimated to total 375,005,000 and toll calls within the state reached a total of 17,465,000, while calls to points outside the state numbered 2,286,000. During the year the investment in plant increased by $4,269 resulting from gross additions of $6,020,000 the difference representing the amount of plant displaced. Additions for 1927 and for succeeding years of a five-year period are expected to be on still a higher level than 1926. The financial statements of the company for 1926 show telephone operating revenues of $12,349,497 and operating expenses of $8,706,529, leaving net operating revenues of $3,642,968. After deductions for uncollectables, taxes, rentals and interest, the net income was $2,390,726. Dividends of $2,000,000 were declared and $50,000 was appropriated to Employees' Benefit Reserves, leaving a balance for corporate surplus of $340,726. The company now has a total of 267,845 stations and a plant investment of over $45,826,000.

Five New Automatic Exchanges at Melbourne

Melbourne, Australia.—Proposed program of Melbourne telephone service, made public in October, 1926, by the engineers of the Post Office Telephones, provides for the construction of 5 new automatic exchanges in the metropolitan area. There are at present three such exchanges now under construction, the first of which should be ready for use in April, 1927, and during the next few years, if the engineers' plans are adhered to, there will be a total of eight aditional automatic exchanges. In November, 1926, there were 17 manual and 4 automatic exchanges in Melbourne.



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Runzel-Lenz makes its testing laboratory one of the strong points of its work in producing telephone cords. Every bit of raw material that goes into Runzel-Lenz cords is subjected to exhaustive analysis before we accept it and begin manufacturing.

This careful selection of the best raw material for Runzel-Lenz cords, our manufacturing operations, representing the benefits of cord making specialization for more than a quarter of a century, and the tests to which the finished cords are subjected before shipment, provide you with assurance that Runzel-Lenz cords are the best your money can buy.

When your cord order reads "Runzel-Lenz" you are buying cords that are protected by every possible precaution against hard handling, moisture, and all of the other factors that reduce cord life.

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RUNZEL-LENZ ELECTRIC MFG. CO.

Specialists in the Making of Cords for Telephone Service

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Bell Long Lines to Set New Record in 1927

New York City.—The construction program of the Long Lines Department of the American Telephone and Telegraph Company for 1927 contemplates plant additions to cost more than $34,000,000, against $29,500,000 in 1926, it is announced by T. G. Miller, general manager. The program provides for plant additions in almost every state. The estimated expenditures will be about 15 per cent greater than in 1926, in which year they were a record.

The proposed expenditures are: Aerial wire, including new pole lines, $3,270,000; long-distance cables with pole lines, loading coils, buildings and equipment, $17,587,000; switchboards and other telephone and telegraph equipment, $8,568,000; line work, including pole replacements, line changes, etc., $4,586,000.

The largest individual item on the program is long-distance cable laying. More than 900 miles of cable were placed by the department in 1926. Plans for 1927 call for more than 1,000 miles of similar cable. Practically all this cable will be jointly owned by the Long Lines Department and companies associated with the A. T. & T. In addition, the Long Lines Department expects to obtain interest in about 400 miles of cable to be installed by associated companies this year.

Under the heading of cable laying for 1927 is included completion of the New York-Buffalo-Cleveland cable line, of which the section between New York and Syracuse is in service; installation of cable between Washington and Richmond to connect with cable in service between Richmond and Petersburg; completion of the Chicago-Terre Haute cable, now in service between Chicago and Watseka, Ill., and the installation of cable at various points between Pittsburgh and Terre Haute. The last named cable is planned for completion, together with cable between Dayton and Cincinnati, Ohio, early in 1928. Additional cables are also to be installed in 1927 on several existing lines.

Spain Plans Increase of Telephones

Barcellona, Spain.—Compania Telefonica Nacional de Espana plans to gradually increase its capital to a total of 1,200,000,000 pesetas, one half of which is to be preferred, and the other half common stock. This company is continuing its program of improving the telephone system of Spain. (1 peseta is worth $.1515.)

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BRIDGING twisted pair to twisted pair, a practical application of the Kearney Solderless Service Connector.
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Kearney Guy Wire Clips Eliminate Serving End of Strand!!!
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The Next Time You Come
to Chicago make your visit a splendid success by stopping at this beautiful new hostelry.
Room and Bath, 1 person —$3.50, $4, $4.50, $5
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Room and Bath, twin beds—$6, $7, $8
Under the personal supervision of ROBERT J. EITEL and MAX EITEL
Delaware Place at Rush St.
Just a few blocks from the Loop

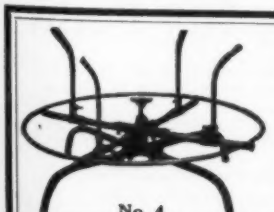
L. M. Ericsson Active in Foreign Trade

Smyrna, Turkey.—An agreement has been made between the city of Smyrna and the L. M. Ericsson Co., granting a concession for 35 years for the installation and operation of a telephone service in Smyrna and the surrounding district. A special company with a capital of about $212,000 has been formed with the city and the company as shareholders. The first telephone station, which will be automatic, will begin with 2,000 lines, to be enlarged later to 10,000.

Mr. Piltz, principal of the undertakings of the L. M. Ericsson company in Italy, states that progress is being made not only in connection with the concession company in the south of Italy, but also with the Società Ericsson Italiano which was formed in Genoa last year. The area of the concession comprises a district in the south about a line drawn between Naples and Rome, and since the company took over the concession in July, 1925, the number of subscribers has increased from 17,700 to 20,376 last October. The Genoa company has also obtained contracts for deliveries for the other four concession districts.

Guatemala Latest Figures Show Deficit

Guatemala City, Guat.—The telegraph and telephone systems of Guatemala are operated by the government as one unit. The combined systems reported a deficit of 13,477,666 pesos ($224,628) for the year 1925 (the latest figures available). Total operating expense for the year was 24,739,046 pesos and total income was 11,261,380 pesos. Two hundred and sixty-one telegraph offices were operating in the republic at the end of the year, 5 of which were inaugurated in 1925. Eleven new central telephone stations were opened during the year making a total of 87 in operation in the country. Total length of telegraph lines in use amounted to 6,871 kilometers. All the national telephone lines in Guatemala had a combined length of more than 3,603 kilometers. At the end of 1925 there were 1,992 telephones in use in the republic, which represented an increase of 775 instruments since December 31, 1923. Work on the new automatic telephone system in the capital city has begun.



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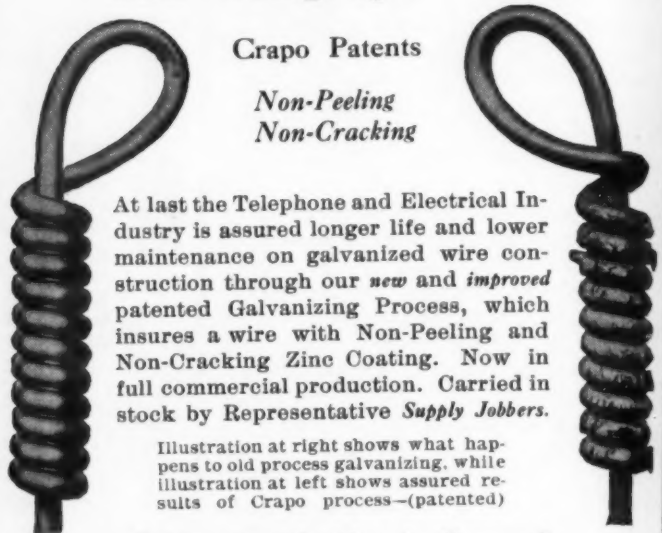
Double Galvanized Telephone and Telegraph Wire



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Non-Peeling
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At last the Telephone and Electrical Industry is assured longer life and lower maintenance on galvanized wire construction through our *new* and *improved* patented Galvanizing Process, which insures a wire with Non-Peeling and Non-Cracking Zinc Coating. Now in full commercial production. Carried in stock by Representative *Supply Jobbers.*

Illustration at right shows what happens to old process galvanizing, while illustration at left shows assured results of Crapo process—(patented)

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Standard or Commercial, Siemens-Martin, High Strength and Extra High Strength Grades

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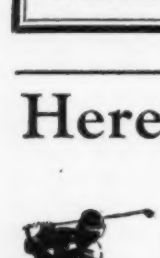

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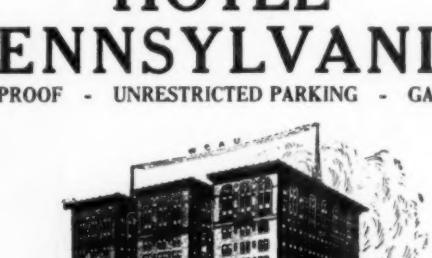

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Knell of Today's Small Companies Sounded by Nebraska Speaker

Lincoln, Neb.—Thorne A. Browne, former state railway commissioner of Nebraska, speaking from his rich experience with the state's telephone industry, predicted the end of the small telephone companies as they now are constituted, at the 28th annual convention of the Nebraska Telephone Association. The meeting was the biggest ever held by the state association. Warren Pratt, president of the Kearney Telephone Company, was re-elected to head the body. F. F. Roderick was elected vice-president, George M. Kloidy re-elected secretary and W. E. Bell, treasurer. George E. Becker of Pawnee City was elected to the directorate to succeed E. B. Wait.

Mr. Browne, in forecasting the passage of the present type of smaller companies due to the demand for better service and its cost, again gave voice to the warning that the necessary mergers and financing be done with utmost discretion and faithfulness to the public interest. Now that Mr. Browne no longer is subjected to the restrictions placed upon him when he was a member of the state regulatory body he was able with propriety to cut loose with the emphatic statement that telephone companies serve too cheaply. He stated that he wasn't advising manager to immediately hiking rates, but to plan to get such security as would be forthcoming when rates were at a point close to the cost and still affording a reasonable return on the investment, and a modest addition to the surplus. He said there remained too much cheap telephone competition in the state. Telephone men should engage on a campaign of education that will create a general demand for good service at a cost that will enable the company to pay dividends, Mr. Browne advised.

There was a prominent place on the Nebraska program for the smaller companies. R. S. Brewster, traffic superintendent at Lincoln, spoke on the smaller companies' traffic problems and F. W. Rulison, outside engineer of plant for the Northwestern Bell at Omaha, outlined the solution to the small plant construction and maintenance problems. He urged his hearers to adopt a plan of periodical and intensive inspection in order that maintenance costs could be kept down and the service stabilized at a highly satisfactory point. Mr. Brewster spoke on the necessity of careful selection and training of operators and furnishing comfortable quarters for them. He advocated making a play for more toll business out of the smaller exchanges. The small towns have stood still from a traffic standpoint, while the larger cities have forged away ahead, Mr. Brewster stated, in advising that the smaller companies begin to take up some of the slack in this matter.

An interesting session on accounting with several specimens of proper accounting operations was staged by I. J. Devoe, chief accountant of the Nebraska Railway Commission. Data on costs of operation of companies was presented by Mr. Devoe. These figures covered not less than four year's history. Graphs of these figures showed that approximately 170 subscriber stations separated each of the periods of highest total costs of operation until the development reached 1,000, after which the costs went down. He brought out that wider adoption of correct accounting methods had resulted in reduction of complaints made to the commission.

Over 50 Per Cent Growth in Year

The state association is in sound financial condition and is enjoying a steady growth, according to the reports of the treasurer and of the secretary. George M. Kloidy, who was re-elected secretary at the meeting, said the association started last year with 70 members and added 36 in the twelve months. The association membership represents 200,000 of the state's 250,000 stations. Mr. Kloidy told of some of the findings of his trips through the state last year, during which he visited practically every company in the state. "Kidding" themselves about earnings in a way that cut down their own salaries, was one of the outstanding faults in many of the smaller companies, he related. He outlined the plans for the district "round-table" sessions to be held during the coming year. He also referred to the legislative activities of the association, particularly to the killing of the proposed bill for 8 hour shifts for operators.

President Pratt, in his annual address, referred to the experience of his own company in getting subscribers to pay for good service when they see what good service is. He also told of his company's performance in completing 97 per cent of its toll calls.

Subscribers' Demands

J. H. Agee, general manager of the Lincoln T. and T. Co., spoke on the average needs of subscribers as dictating the demands that each company had to meet. "If every wish of the subscriber were met, the company would go bankrupt," said Mr. Agee in telling of what constituted reasonable demands. Despite all statements of the premium placed on the customers' minds on good service, Mr. Agee maintained that the rate is the primary consideration. He told of the development of modern telephone commercial practice and the free services that had been eliminated as evils.

Backbone, he stated, was the necessary factor in getting satisfactory and profitable relations.

J. W. Gunn told of some details of the workmen's compensation and employers' liability insurance, and suggested that utilities watched the outcome of the compulsory insurance law now before the Massachusetts legislature.

H. T. Dobbins, associate editor of the Lincoln State Journal, recommended that the telephone manager make news contacts with his local newspaper men. Too many irons in the fire and lack of courage, Mr. Dobbins cites as faults of a number of telephone managers. A telephone company that is not prosperous and doesn't have well paid employes is a drag on the community, Mr. Dobbins said, and in bringing out his point showed that only one company out of every 36 of the reporting 237 class F companies paid a dividend in 1925, and that of the 199 others, including the Lincoln and Bell companies, only one in three paid dividends that year.

The less government interferes with business the better it is for all concerned, said Chairman H. G. Taylor of the state commission. There are rare instances of making the commission the goat and the popular misconception of the commission as a punitive body is being dispelled, said Mr. Taylor in telling of the operations of the commission.

Charles Deering, secretary of the U. S. I. T. A., spoke on dangers of selling telephone properties to buyers who were not qualified to conduct the business on a sound basis, and warned of the peril of exploitation by irresponsible parties.

Elliott Belden, director of public relations for the United Telephone Co., Abilene, Kan., told how advertising had helped his company increase exchange revenues and placed a survey of market possibilities as the first step in planning a development campaign. Standardization of directory practice and the successful methods employed in directory publication were outlined by R. M. Woolfolk, directory supervisor for the Lincoln T. and T. Co.

L. F. Wood, transmission engineer for the Northwestern Bell, gave an interesting and practical address on transmission, treating particularly of the toll line phase of the subject. Secretary Thomas Phalen of the South Dakota Association and Secretary L. M. Kraege of the Kansas state organization spoke briefly, both of them stressing the value of exchange of ideas as a tangible benefit of state association membership.

F. C. Builta, assistant to the president of the Northwestern Bell, speaking on "Publicity in the Telephone Industry," identified the operator as the most useful instrument for obtaining public confi-

dence. He urged that telephone companies present prosperous and business-like appearances at their offices as the public judges the companies to no small degree by the looks of its headquarters. He also recommended that the utilities acquaint the public with the restriction of profits by commission regulation as a prevailing idea is that there is "big money" in the telephone industry because of the lack of competition.

An annual banquet with Lt.-Governor George A. Williams spoke, several motion picture presentations and playlets showing the right and wrong way of handling complaints, provided the entertainment features of the convention.

United Trust Company to Handle Utility Financing

Abilene, Kan.—United Trust Co. has been organized here by a group having had public utility connections for the last 30 years. The new company has a capital of $500,000, and will be operated under the supervision of the Kansas state banking department.

In addition to its financing operations for telephone companies the United Trust Co. is making available an engineering service on either a consulting or management basis.

George Long, Pay Station Chief, Tells Its Story

Hartford, Conn.—George A. Long, vice-president and general manager of the Gray Telephone Pay Station Co., and the man who made "Drop a nickle, please" one of the busiest phrases in the vernacular, recently addressed the Hartford Rotary Club on the part that city played in the development of the telephone. Mr. Long detailed the growth of the pay station and related a very interesting tale of the important part the pay station occupied in the extension of telephone use.

Kearney Announces Sales Appointments

St. Louis, Mo.—The James R. Kearney corporation announces the following additions to its sales organization:

Oscar H. Davidson Equipment company of 1633 Fremont avenue, Denver, Colorado, as representatives in the Denver territory; L. Brandenburger of 149-151 West 2nd South, Salt Lake City, Utah, representative in the Utah and Arizona territory; Theodore B. Dally, 303 E. No. 30 Church street, New York City, as district representative in the New York and New Jersey territory, and E. C. Dwelle, Room 1401, Allen Bldg., Dallas, district representative in Texas and Louisiana.

H. C. Fiske, assistant engineer of the Matthews corporation has been transferred to the position of district representative in the southeast territory, with headquarters in Atlanta, George A. Ackerman, 658 Victor Road, Erie, Pa. has been named representative in the Pittsburgh territory, covering Pennsylvania, Ohio, and part of New York.

J. E. Sumpter, well known telephone supply man now is Kearney's district representative in the Minnesota territory, with headquarters in the Security Bldg., Minneapolis.

Indiana Opens Trans-Atlantic Service

When trans-Atlantic service from Indiana was opened a group of notables listened in as President C. H. Rottger of the Indiana Bell talked.

Telephone Mergers

THERE are many Telephone Companies in which consolidations could be effected to advantage, as thereby they would be enabled to finance extensions, make improvements, refund outstanding obligations and generally place themselves in the strongest financial position.

We are prepared to investigate the possibilities for new development, purchase or consolidation in the Independent Telephone Field, and have facilities for financing such projects as shown by our engineering and financial analyses to have warranted merit.

We shall be glad to advise with you and answer any investment questions. No fee or obligation of any sort is attached to this investigation.

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London's Service Shows Big Growth in 1926

London, England—The telephone system of London is growing with marked rapidity, the past year having been one of increase in every department, and many interesting figures are given in a statement of London's telephone progress which has just been issued.

At the end of 1926 there were:
298,766 exchange lines.
519,969 telephones working.
112 London area exchanges.
22,970 private exchanges.
97 automatic private exchanges.
15,400 private wires not connected to exchanges.
4,686 call offices.

All these items showed considerable increase on 1925. The 500,000th London telephone was installed at the House of Commons on July 16 last, and was formally handed over to Mr. Harvey, chairman of the press gallery, by the controller of the London Telephone Service, W. A. Valentine. This particular instrument bears a commemorative tablet.

During 1926 seven new exchanges were opened, two of them replacing closed exchanges. The increase of lines to exchanges was 28,965, or about 10.7 per cent. In the case of telephones the net increase was 43,156, or about 9.0 per cent. Private branch exchanges increased by 1,970, and of these 97 are automatic. A total of 283 more call offices were installed, and of the total number of call-boxes, 418 kiosks were available night and day. Toll and trunk facilities were extended to call-box kiosks, together with the dictation of telegrams. The development in the business areas of London, according to the observations of the telephone officials, has not been as great as expected, but there has been a substantial increase in the rate of development in the suburban area. The extraordinary building development in the outer London area has made it specially difficult to determine anticipated growth in these areas and to provide for future requirements.

In addition to the seven new exchanges, extensions to 47 exchanges were carried out, providing 33,000 additional lines. Plans have been approved for five new manual exchanges to replace existing equipments, and consideration is being given to schemes whereby a further increase in capacity of 91,000 lines will be secured in the near future. Eleven new telephone exchanges are in process of construction, and sites for 29 additional exchanges have been obtained. In a number of these cases plans have been prepared and building will shortly be started.

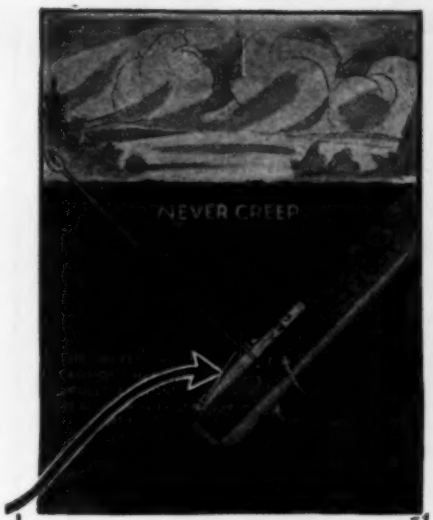
The ultimate conversion of the London area to automatic working has presented many complex problems, but a system has been designed to meet all the required conditions. Specifications for exchanges to accommodate more than 100,000 automatic lines have been issued, and others are being prepared. The installation of automatic equipment is in progress in four central London exchanges, and some of these should be available for service during 1927. "Tandem," which is to provide the all-important link between subscribers to the automatic system and those continuing for the present to use the ordinary manual exchanges, will shortly be available for service.

If the anticipated rate of telephone growth is realized it will be necessary during the next five years to construct and open 60 automatic exchanges within ten miles from the center of London. These new exchanges will provide for the replacement of worn-out plant, as well as for growth. The London telephone directory now contains 268,500 entries, and during 1926 over 700,000, weighing approximately 1,500 tons, were issued.

Improvement of speech transmission by means of large-gauge conductors and "loading" and the increasing use of underground cables are other features of the progress in 1926. Advantage is being taken of road re-paving and other street work to reduce inconvenience to traffic to a minimum in connection with work on underground cables. Additional underground cables for toll and trunk circuits, with repeater stations on several main routes have been installed.

Improve Toll Service

Communciation with continental Europe has been improved and traffic over Anglo-Continental lines continues its upward tendency. The outgoing calls during 1926 were 20 per cent above those for the previous year, and the Anglo-German traffic is increasing rapidly. At present there are 53 international circuits, of which 21 terminate in France, eight in Belgium, twelve in Holland, and twelve in Germany. Four circuits are now available to Berlin, four to Hamburg, and one circuit each to Cologne, Frankfurt, Dussenldorf, and Bremen. Additional circuits to France and Belgium, necessary to meet the increased demand for service to these countries, are nearing completion, and it is anticipated that they will shortly be in operation. Sixteen new trunk positions have been installed in the trunk exchange to accommodate growth. A new French cable, containing 42 pairs of wires, is nearing completion, and this, together with the appropriate land lines, will, when available, improve the existing Anglo-French service and provide direct



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Have Superior Holding Power

In sandy, moist, adobe, or any other soils, the great holding surface of the NEVER-CREEP and its pull against solid, undisturbed earth gives an anchorage that is unsurpassed.

The more you look into anchor construction and performance the more you realize that undisturbed earth to pull against is a vital consideration. Tamping very seldom suffices to give the holding condition an anchor needs. Moisture seeps down to the holding plate of the anchor and collects there with a great sacrifice of the anchor's rigidity. You know how these factors ruin holding power, so play safe by standardizing the NEVER-CREEP and get away from the perils that are bound to come when the earth is disturbed during anchor installation.

The NEVER-CREEP alone has the Thimbleye rod.

Foremost wire companies prefer the NEVER-CREEP. So will you when you learn its complete story. Write us for details.

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Made in Canada by
N. SLATER CO., INC.
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W.E. Switchboards

W. E. No. 9 three-position board, of three sections of one position each.

Equipped with 180 lines.

Cord circuits equipped for party line ringing

Mahogany finish.

Excellent condition.

Prices and details on request.

BUCKEYE TELEPHONE AND SUPPLY COMPANY

COLUMBUS, OHIO

T. W. TURNER—Cable Splicing and Repair Work. Jobs done by Hour or Contract. Satisfaction Guaranteed.

Deerwood, Minnesota

Swiss and Italian services. A new submarine cable has been laid between England and Belgium, providing 21 additional circuits. These will greatly improve the existing Anglo-Belgian service and provide for its future growth.

The number of local calls originated in London during 1926 was 499,473,766, an increase of 4.9 per cent, and one feature of the development to which attention might be drawn is that the increase of originated calls is not quite commensurate with the growth of subscribers, and it appears that the average number of calls made per subscriber is decreasing. According to an official, "the acquisition of the telephone habit requires time for its development, and the new subscriber does not, at the outset, make use of the telephone with that freedom which characterizes the more experienced user. In a rapidly developing system the accession of blocks of new subscribers with low calling rates tends appreciably to depress the average calling rate over the whole system. Trade depression also has an adverse effect on the calling rate."

The proportion of telephones to population in London is 1 to 14.90, and the percentage of ineffective calls due to "line busy" is 11.8. In connection with the London-New York telephone service, it is stated that in the present state of technical knowledge there will be occasions, more particularly in the late afternoon, when atmospheric conditions will prevent continuous effective conversation, and that allowance will be made in charging for individual calls when the conditions have been difficult.

Flexible Wiping Cloth for Bettering Joint Work

Minneapolis, Minn.—George Williams, 3 East 26th street, Minneapolis, is the inventor and sole maker of formed flexible finished wiping cloths that are getting a big play from cable men. These cloths save time, labor and solder in wiping narrow, uniform joints. They come ready for use and require no breaking in.

Mr. Williams says of his invention:

"The only mechanically made wiping cloth ever manufactured; the only wiping cloth on the market that can be used successfully on the first joint. You are certain to wipe more uniform and smoothly finished joints.

"It is that permanent true curvature of the cloth that makes it a decided advantage over the old style shapeless cloth in forming the soft solder into a uniform body around the joint. This point together with the fact that there is no time wasted and no wear on the cloth in breaking in makes the formed-finished cloth worth more than its price to any joint wiper.

"There is no stiffening of any kind used in the forming process; the form is obtained solely by pressure in the presence of heat and every cloth can be worked up to any desired flexibility by bending in the fingers, but you can't take out the perfect curvature. The firm press takes the clumsiness out of the cloth.

"The finish of the wiping surface is obtained by soaking the first few plys in hot tallow after which it is given two applications of a powdered dressing which is forced into the grain of the cloth by two operations on a hardwood rotary polisher, leaving a smooth slick surface to which solder doesn't stick.

Fort Wayne Gets Graybar's Sixty-first Branch

Fort Wayne, Ind.—Recognition of Fort Wayne's industrial and commercial growth has influenced the Graybar Electric company to select this city as the site of its sixty-first distributing house, located at 921 Barr Street. The house will carry a complete stock of electrical supplies for industrial, contracting and merchandising requirements. It has 12,000 ft. of floor space, ample to insure complete stocks of quality electrical supplies to meet Fort Wayne's rapidly growing demands.

UNIQUE BLOW TORCH

It starts quickly, operates in any position, and produces a remarkable heat. It is a great worker in cold and windy weather.

The automatic orifice cleaner, one of the details shown in the illustration, is but one of a number of exclusive features that make the Unique your greatest value in blow torches.

Painstaking care by interested workmen, an actual "burning test" before shipping, is just another detail responsible for their uniformity and efficient burning qualities.

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Unique Manufacturing Co.
221 Whiting St. CHICAGO, ILL.

Everstick

Approved by Large Operating Companies For the Following Strains

6" 2-way	2,200 lbs.
6" 4-way	6,000 lbs.
8" 2-way	6,000 lbs.
8" 4-way	10,000 lbs.
10" 4-way	16,000 lbs.

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Santa Monica, Cal.—Santa Monica leads Pacific Coast in percentage of telephone growth during 1926 with 15.8%. Alhambra comes second with 12.27%.